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TUESDAY—NOVEMBER 15

Chairman—MALCOLM ROSS, Editor, University of Miami Publications, Coral Gables, Florida.

Welcoming Address By I. D. MacVicar

Mr. Hugh Peters, our chairman, has been prevented from attending the opening of this conference by other county business that could not be postponed. He has asked me to express his regrets and to extend to you, on behalf of the people of Dade County, a cordial and hearty welcome.

It is a great pleasure to welcome to Dade County the Second Annual Session of the Gulf and Caribbean Fisheries Institute. We congratulate the Marine Laboratory of the University of Miami for presenting the Inaugural Sessions here in August of last year. At that time the future of the Institute depended, in large measure, upon the interest taken in that first program. A gratifying result is the fine attendance at this, the Second Session.

The first Institute brought together representatives of the sports fishermen, commercial fishermen, fishery biologists, technologists, economists and conservation officials. That Inaugural Session truly embraced the Gulf and Caribbean Fisheries, as almost every county and state bordering on these waters was represented. Our own Federal government sent top-level scientists and administrators. The success of the Institute was thus assured from the outset by such participation.

One of your speakers last year stated that salt-water sports fishing alone was valued at \$625,000,000.00 in 1947, and the entire industry at almost one billion dollars. That is no fish story, gentlemen, but a statement of fact—a statement that emphasizes the importance of the fishing industry to the economy of all Caribbean countries.

Those of us who have lived in Florida for many years are fully conscious of the almost irreparable damage that has been done to our marine life by some irresponsible developers and promoters. Perhaps we can never reclaim the beauty and plenty of the old days, but if there is one chance left, it will rest in capable hands such as yours. Our governing bodies will do well to heed your counsel and welcome your recommendations. Therein lies the only hope of preserving and protecting marine resources that mean so much to all of us.

In that connection, I should like to report that a Dade County Aquarium and Marine Laboratory on Virginia Key is not by any means a dead issue. It is true our first financing plan was not successful, as the private interests withdrew after forfeiting \$50,000.00 to the County. This money has been deposited in a special aquarium fund, and the Board of County Commissioners is now working on a plan that we have every reason to believe will be successful. Under this plan the County will own and operate the Aquarium instead of leasing to private interests. It is our intention to construct a Marine Laboratory for the University of Miami, at no cost to the University, and it is our hope that the staff of the Marine Laboratory will, in turn, help us with the technical operation of the Aquarium. We have given top priority to this project and hope that by the

time you hold your next annual meeting, construction will be well under way.

I trust your meeting here will be the success it deserves to be, and that your stay in Dade County will be such a pleasant one that you will return again and again to our shores.

Opening Address

F. G. WALTON SMITH, *Chairman*

MENTION WAS MADE at last year's meeting of the failure of mankind to maintain food production ahead of population increase. This is not a problem for the future. The race is already lost to the extent that over 20 million persons are reliably estimated as dying each year from the direct or indirect results of undernourishment.

No apology is made for introducing this year's meeting with the same theme. Since last year the population of the United States alone has increased by something in the order of 1,000,000, and the world population by at least twenty times this figure. The problem becomes more serious with each passing year.

Although in the United States we are ahead in the population-food race, the margin is decreasing. In the Caribbean area the crisis is closer and has become a major economic problem already, inasmuch as the area is not self-supporting. The British West Indies alone import from Canada the equivalent of about 100 million pounds of fish, and the population is still increasing.

These problems concern all of us present at this meeting. With the drive to produce more and more food it becomes increasingly important for the fishing industries to extend their sources of supply and to conserve and stabilize existing sources, by wise regulation.

The function of the Gulf and Caribbean Fisheries Institute is to aid in the expansion and conservation of fisheries in the area by bringing together those to whom it is of primary concern. We welcome not merely scientists, but representatives of government administrations, economists, fish dealers and the fishermen themselves. These various groups will, during the next few days, discuss their own special problems, and in addition, will attempt to unify efforts by exchanging ideas and information with other groups in general session.

The problems with which we are concerned include the basic facts of the biology of fishes and the basic oceanography which determines their distribution. We are also concerned with the need for exploratory development of the fisheries, with the problems of transportation, distribution and marketing and with the economic conditions of the fishermen. We welcome the speakers in these various fields who represent the governments of neighboring states and the countries of the Caribbean and we welcome those from scientific organizations and representatives of the industry who will discuss problems from their respective viewpoints.

Many problems in this area have more than local significance and, as a result, we are privileged to have as participants experienced men from other parts of the United States. To all of these we extend a hearty welcome.

The U.S. Fish and Wildlife Service has contributed in great measure to the program in front of us. The success of our deliberations will also reflect the close cooperation of the Atlantic States Marine Fisheries Commission and the newly organized Gulf State Marine Fisheries Commission. Part of the program

is based upon suggestions made by the Caribbean Commission. In short, we have the most auspicious conditions for our purposes and we may regard the Institute in this respect as a catalyzer.

This viewpoint is perhaps particularly important today. A considerable amount of individual uncoordinated research has been carried out in the past, in the area with which we are concerned. Perhaps we may now aid each other by assessing these scattered efforts and preparing ourselves for a reorientation of future work in the direction of cooperative and integrated research and development. The program is arranged so that the conclusions reached in each session will be specifically reported and so that definite recommendations may arise from the joint efforts of us all. It may not be too much to hope that, during the next week, the foundations may be laid for a New Deal in the fisheries work of the Gulf and Caribbean.

TUESDAY—NOVEMBER 15

Chairman—J. L. BAUGHMAN, Chief Marine Biologist,
Texas Game, Fish and Oyster Commission, Rockport, Texas.

Recent Research On The Florida Oyster

ROBERT M. INGLE, *Assistant Director, Oyster Division,
Florida State Board of Conservation.*

THE APPROPRIATION made by the 1947 legislature establishing the Division of Oyster Culture carried the stipulation that all funds were to be used for "Rehabilitation of the natural oyster beds of the State." Accordingly, research has been limited to facts relating to the basic biology of the Florida oyster, such as intensity and place of spawning, length of spawning period, growth rate, salinity optimums, etc. This information is combined with knowledge of glycogen content of oysters from selected spots in the State to select the most desirable locations for rehabilitation work.

A general survey of the west coast has been made and several localities seem promising. Besides Apalachicola Bay, favorable areas noted were Milton, Panama City, Spring Creek, Panacea, St. Marks, Horseshoe, Cedar Key and Crystal River. Further efforts will be brought to bear to revive the industry in these areas.

A steady supply of fresh water seems to be the critical factor in most areas of the west coast. Every effort should be made to find localities such as Indian River on the east coast which can depend upon a year-round, unfailing source of fresh water which will not be too much at one period of the year and too little at another.

Fluctuation of salinity has been found to be harmful on a short time basis, as well as seasonally. A variation of 8 to 10 parts per thousand within 10 or 12 hours or less, such as might be found due to tidal action, seems to retard growth and have a deleterious effect upon the quality of the meats. Much experimental evidence is accumulating that the best oysters in Florida grow in areas where the salinity does not vary more than 5 parts per thousand, from day to day, with a 1 - 2 part variation being ideal.

Another critical item in Florida's oyster culture is the purity of water. Many areas of the state that previously were leading producers are now producing little or nothing because of pollution. The pollution is of two types, sewage and industrial. Studies have been begun to ascertain which times of the year sewage pollution is absent. It is well known that when the salinity of water is raised, enteric organisms tend to decrease. By fishing only during such periods in polluted areas it may be possible to harvest many thousands of barrels of oysters that are now permanently condemned. This plan has been used in Apalachicola Bay with marked success.

The other aspects of the pollution problems are to be studied in the immediate future. In the meantime every encouragement is being given to municipalities to establish adequate sewage treatment facilities.

Factors favoring an increased oyster production in Florida are several. An

extremely heavy spat fall was noted in all areas harboring oysters and a reliable source of seed is therefore almost assured. Growth is especially rapid. It was found that cultch planted in the spring would produce marketable sized oysters by the latter part of the ensuing oyster season. By comparison, northern oysters would require three to four years to attain a similar size. The growth is also continuous throughout the year, whereas in northern waters the growing season extends only through the warmer season.

An exceptionally long spawning has been found to exist. In Apalachicola Bay spat falls from the first of April to the first week of November. Studies further south indicate an even longer period of spawning.

Dr. Pierce, who collected plankton samples at Cedar Key, Bradenton, and Fort Myers monthly for a period of a year, very generously made his collection available to the author. Cedar Key plankton only has been studied to date. Oyster larvae were found for all months but three: January, February, and March. The samples from Bradenton and Fort Myers, which have not yet been examined, should prove interesting.

The usual oyster parasites and commensals have been found to be of exceptionally low incidence in Florida. *Nematopsis* infestation is light, as is *Polydora*. Boring sponges are present in large quantities in very few localities, none of which are of great potential value to the industry. Boring clams are not abundant in the principal areas of production. A great variety of predacious gastropods do exist, however, and the author has found strong evidence that *Melongenacornu*, and *Busysca perversa*, as well as the already incriminated *Thais haemastoma* annually ravage the oyster beds of the State. Studies should be made on these with the aim of control. Exploration should be made into the possibility of using these snails as bait, fertilizer, or other commercial products.

In summing up, an optimistic conclusion is difficult to avoid. The potentialities for Florida oyster culture are great. The waters of the Peninsular State confer potent advantages to oysters which eventually can lead only to greatly increased production if exploited.

The Texas Oyster Situation

J. L. BAUGHMAN, *Chief Marine Biologist,
Texas Game, Fish and Oyster Commission.*

TEXAS OYSTER REEFS are, in general, characterized by their extreme depletion or entire absence. Oyster production dropped (in 1948-49) to an all time low of 12,951 gallons, or about 7000 pounds. The 1949-50 season will probably be at least as bad or worse. This drop has been due to a number of things, including over-fishing.

In a recent survey of the area made by Dr. Philip Butler of the U.S. Fish and Wildlife Service, and Mr. Byron B. Baker, Jr., of the Texas Game, Fish and Oyster Commission, the condition of the reefs was summarized by Dr. Butler as follows:

"Oyster reefs of the entire area were characterized by their serious depletion resulting from either over-fishing, drill predation, or both. With few exceptions, the oyster meats were of only fair to very poor quality. The high incidence of boring sponge and boring clam are probably the primary agents in causing this poor quality as (a) oysters living in marsh ponds cut off from infection with sponges and clams were of excellent quality even though salinity levels were

as high or higher than on adjacent reefs in open water and (b) oysters exposed at low tides, which automatically controls sponges, were of better quality than adjacent oysters which were heavily fouled with sponges.

"There were indications that oysters growing in deeper waters were better than those on shallow reefs. Oysters of satisfactory quality were found primarily in areas having salinity levels below 20 ppm, such as stations 67, 57, and 28; these reefs are located near the junctions of primary and secondary bays; while fouling and predators are partially controlled at these levels, there is the possibility of mortality due to excessive run-off of fresh water in some years.

"The absence of feeding at many locations indicates that the plankton may be low quantitatively and that poor oyster quality may be due to a small food supply, which may be of importance in determining the density of seed plantings.

"The topography of the bottom, consisting of elevated ridges and towheads surrounded by soft mud, suggests caution in attempting to expand reefs so that natural siltation areas will be avoided.

"Areas infested with drills are those having greatest access to waters of the Gulf, and the drill population will probably fluctuate regularly with the run-off from the several rivers.

"In areas where commercial harvesting was observed, the rate of spatfall was insufficient to maintain the reefs. The presence of spat of less than $\frac{1}{2}$ " diameter at many stations suggests that there is an important winter spatfall, or else that in these locations, the spat are extremely slow growing. These two possibilities should be investigated since other locations showed that there was a single important spatfall some months before this survey."

So much for the physical and biological aspects of the question.

There is another, and less frequently recognized, side to the matter. This is the fact that the laws of Texas, well intentioned though they are, do little to encourage the culture of oysters so badly needed to replenish our reefs. It would be bootless to discuss these laws at any length here. Suffice it to say that the following legislative changes are suggested, although further knowledge may lead to their modification.

All oyster reefs in the public waters of the State of Texas, except those set aside as seed beds, or as public reserves, shall be open to lease for oyster culture, and may be held for an indefinite period, subject to the following provisions:

1. Leases shall be acquired only by bidding (either sealed bids or at auction) as the state may direct, in substantially the same manner as oil leases are now made on state land.

2. The original bid shall serve as rental for five years.

3. After five years have elapsed, a rental of \$2 per acre per year shall be paid by the lessor.

4. It may be desirable to require a royalty on any oysters produced from such a lease.

5. Any lease from which no oysters are produced in five year period should revert to the state, even though the lessor is willing to continue to pay the rent. The object of this is to encourage oyster culture, not the idle possession of land or bottom for other purposes.

6. Such leases to be transferable so long as the bottom is to be used for oyster culture.

7. The position of our present oyster law limiting the holdings of any person, persons, firm, company, or corporation should be modified to this extent. When

any of the individuals mentioned above can show that he has his original 100 acres under valid cultivation, then he may, at the discretion of the Commission, be granted such additional acreage as he may need to expand his legitimate operations.

8. Any man taking oysters from the waters of the state, either from his own lease or elsewhere, shall return to the water 25 per cent of the shell remaining after shucking operations. He may place this on his own lease, under State supervision, to improve it, or should he decide that such shell would damage rather than improve his lease, then he shall return such shell to the water wherever directed by the Game, Fish and Oyster Commission.

9. A valid corollary of the above would then be the closure by regulation of all reefs not under lease. This would not remove such public reefs from availability for lease, but would insure that only those reefs leased, and in which an individual owner had sufficient interest to conserve them, would be worked. Every inducement should be given to the man wishing to work his lease, which should be easy to get, and promiscuous oystering on the public reefs should be discouraged. This would give the wild stock a chance to recuperate, and, if it was desirable, such reefs could be opened from time to time for public fishing.

In view of the findings of Dr. Butler and Mr. Baker, summarized above, the following program has been outlined, for immediate attention on the part of the Commission biologists:

1. Experimental plantings should be continued to determine the optimum locations for oyster culture with respect to environmental conditions. Under this heading would come (a) Establishment of oyster beds at Bird Point, in deep water on the west side of Aransas Bay, and others in an area of significantly lower salinity such as San Antonio Bay. (b) Maintenance of small experimental plantings at previous experimental plots to determine changes in environment.

2. Spatfall and spat survival rates should be determined, using test cultch, and these should be correlated with plankton analyses and hydrography. Stations should be established in areas of high and low salinities and on experimental as well as commercially productive reefs.

3. Mudshell and the "fines" resulting from shell dredging operations should be tested to determine their fitness for stiffening various types of bottoms. Initial tests should be made on Long Reef and on a new area near the laboratory.

4. Routine collection of data on hydrography and plankton should continue for correlation with oyster quality and productivity, and a permanent station should be established near the laboratory where comparable data may be collected over a period of years.

Besides the legislative changes and biological objectives outlined above, there is need for an extended program of long range research, covering the following objectives:

1. Further study is necessary of the environmental features which will determine areas suitable for the cultivation of marketable oysters, together with investigation of the costs and methods for improving and expanding natural reefs as well as for establishing new reefs in suitable areas. Detailed information on the following points will be required to reach a satisfactory conclusion:

- | | |
|----------------------------|------------------------|
| (a) Spatfall and survival. | (f) Fouling organisms. |
| (b) Growth. | (g) Oyster quality. |
| (c) Mortality. | (h) Salinity. |
| (d) Feeding and fattening. | (i) Temperature. |
| (e) Predators | (j) Turbidity. |

- | | |
|---------------------|-----------------------------------|
| (k) pH. | (o) Bottom strengthening methods. |
| (l) Currents. | (p) Plankton analyses. |
| (m) Nutrient salts. | (q) Population analyses. |
| (n) Bottom quality. | |

2. It will be necessary to properly evaluate existing and potential oyster resources. Surveys should be made of the size and location of existing reefs with analyses of their oyster population.

3. Factors affecting oyster culture should be studied where localized problems in pollution may occur. It is also necessary to gain understanding of the problems imposed by domestic and industrial pollution; and a survey is needed to determine the extent and effect of these factors on the oyster population.

4. Investigation of the fundamental aspects of oyster biology and the devising of experimental techniques to verify or evaluate field observations are necessary parts of this investigation.

5. Dissemination of scientific data so collected should be made available to the public and to legislative bodies for their information in enacting conservation laws relating to the oysters.

The author is deeply indebted to Dr. Philip Butler of the U.S. Fish and Wildlife Service for much of the biological data used in the preparation of this paper.

Studies On The Edible Oyster Of Puerto Rico

N. T. MATTOX, *Professor of Zoology*
College of Agriculture and Mechanic Arts
Mayaguez, Puerto Rico.

FROM NOVEMBER, 1946, hydrographic records of the environment and biological studies of *Osirea rhizophorae* Guilding, the common edible oyster of Puerto Rico, have been carried out. This oyster is found attached to the aerial roots of the common mangrove, *Rhizophora mangle* L., in various lagoons around Puerto Rico. This habit of growth has given the name "mangrove oyster" to this species. These studies have been conducted in the Boqueron Lagoon, on the south west coast of Puerto Rico, where one of the largest colonies exist. This lagoon is approximately 1½ miles long by ½ mile wide and is entirely surrounded by mangroves bearing oysters.

This colony of oysters is of considerable economic importance to the fishermen of Boqueron. It is estimated that from 2,000 to 10,000 oysters are taken from this lagoon each week throughout the entire year. Based on average samples of marketed oysters, at least 25,000 pounds of oysters are taken from this one lagoon during the period of a year. These oysters are sold only in local markets and are considered by many to have a flavor superior to that of *O. virginica*. Problems of controlled harvesting of these oysters have been considered. Because of the continuous harvesting practices the marketed oysters are not of a large size. The average marketed oyster is little over 55 mm. in shell length. The largest specimen observed in this lagoon had a shell length of 96 mm. It is probable that larger oysters could be obtained by regulating the "picking" of the oysters in different parts of the lagoon.

Hydrographic observations indicate that this species lives under environmental conditions different from those of *O. virginica*. The salinity of the waters is much higher, averaging about 35 parts per thousand. Extremes of high salinity,

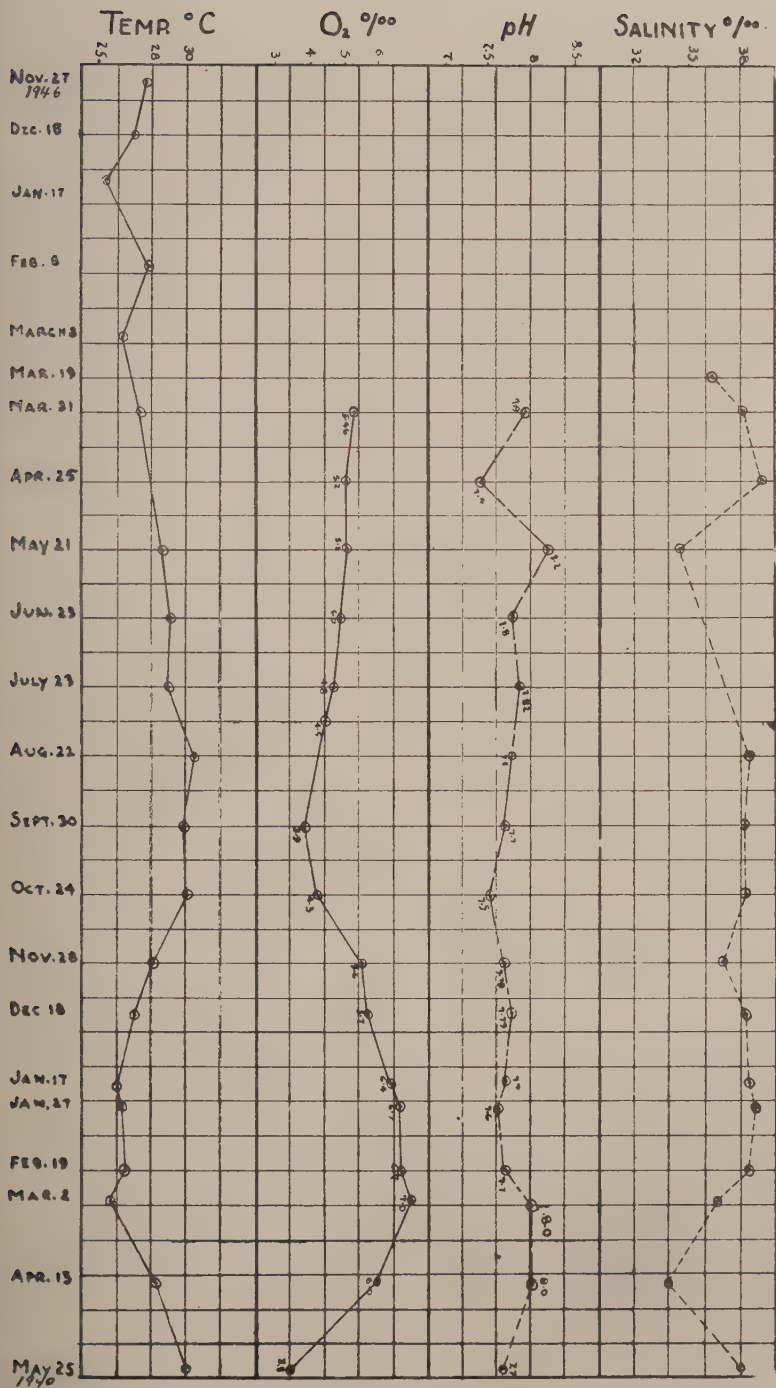


FIGURE 1

after extended dry periods, up to 44 parts per thousand have been recorded. Also, after very unusual heavy rains during the fall of 1949 when the flow of fresh water from a nearby fresh water lagoon was abundant, a salinity average of 16.8 parts per thousand was observed. However, nine days later the salinity was up to 28.9 parts per thousand, and up to 34.4 parts per thousand the following week.

The water temperature here is uniformly high. The extremes observed were from 25.0° to 31.0°C. Oxygen content of the water varied, inversely with the temperature, from 7.0 per cent to 3.7 per cent. The pH of the water varied from 7.4 to 8.2 (Figure 1.).

Studies on the rate of growth of adults and spat were made. Individuals attached to mangrove roots and to artificially furnished cultch were studied. The mature individuals grow at a rate of 0.12 mm. per day, and spat grow 0.25 mm. per day.

This species is dioecious with an observed sex ratio of approximately 5 females to 4 males. They are sexually active throughout the entire year; setting of spats has been observed during all seasons.

Reference is made to a detailed study by the present writer, "Studies on the biology of the edible oyster, *Ostrea rhizophorae* Guilding, in Puerto Rico." Ecol. Monog. 19:339-356, 1949.

Potentialities Of The Gulf Oyster Industry

LEWIS RADCLIFFE, *Director, The Oyster Institute of North America*

THOSE FAMILIAR with conditions in the Gulf states oyster industry will admit that there is room for a vast increase in production. It is not necessary to look further for one of the prime causes of this condition than to note the small percentage of grounds under lease. A recent survey made by the author revealed that there were only 25,000 acres under lease, as compared with an estimated 916,000 acres of natural oyster grounds not under lease. In other words, less than three per cent of the total acreage is being cultivated. It is only necessary to recall that of the oyster production in Massachusetts, Rhode Island, Connecticut, New York and New Jersey, about 98 per cent of the annual harvest comes from cultivated grounds, to appreciate the value of oyster cultivation in maintaining the industry at high productive levels. From the experiences in Maryland and other states it must be concluded also that the amount of money required to maintain production on public grounds is far too great to be achieved by subsidies or direct taxes. If these statements be admitted as facts, then the solution to the problem of creating a flourishing oyster industry is through the enlistment of private capital in the leasing and cultivation of oyster bottoms. If this be true, then state governmental agencies should take necessary steps to encourage the leasing of grounds for private cultivation on a sufficiently large scale, and without encumbering provisions, to make it really worth while for private capital to enter this field. Furthermore, as a result of the extensive researches sponsored by the oil interests, state and federal laboratories engaged in studies of the problems of the oyster industry, there is being accumulated a tremendous backlog of valuable information, far greater than any other area within the realm of oyster production. When this can be released to the public it should prove to be of inestimable value in the development of increased production of oysters.

Now that there is a Gulf States Marine Fisheries Commission it is hoped that the Commission will make one of its major objectives the fostering and development of the oyster industry of the Gulf. There is no objective with greater promise of increasing the productive wealth of the Gulf coastlines. If it has not already established a section devoted to the problems of the oyster industry, to furthering its development, it is to be hoped that this may become an established fact shortly. The Atlantic States Marine Fisheries Commission has already demonstrated great capabilities in coordinating the efforts and furthering developments in other comparable fields.

The future development of the oyster industry is not so much dependent on an increase of our scientific knowledge of what to do as it is upon political consideration and practical application of knowledge now available.

Latent Oyster Resources Of Florida

PAUL S. GALTSOFF
U. S. Fish & Wildlife Service

ACCORDING TO THE STATISTICAL DATA for 1945, Florida contributes annually to the national supply of sea food only 1.6 million pounds of oyster meat, or less than 2 per cent of the average annual production of oysters in the United States. About 93 per cent of this quantity are produced by public oyster grounds and only 7 per cent are harvested from privately leased bottoms. The west coast of Florida contributes the greatest part, namely about 1.5 million pounds and is therefore much more significant than the east coast, which produces only 0.7 million pounds.

In relation to the very long coastal line of the State the total harvest of oysters is very small. Furthermore, the yield of oyster meat is very low. One standard bushel of Florida oysters averages only 3 pounds of meat as compared with 7 or 8 pounds obtainable from a bushel of oysters in Long Island Sound and in Delaware Bay. The low figure of yield is an index of a poor quality of oyster meats, which is typical for the wild oysters usually found on public grounds.

Fifty or more years ago the Florida coast abounded in oysters, the quality of which, especially of those from Apalachicola Bay and adjacent waters, compared favorably with the best oysters produced in the country. Thus, the present situation cannot be entirely attributed to unfavorable natural conditions. It is reasonable to conclude that the decline in the productivity of bottoms and poor yield of oyster meat are the results of the lack of management of public oyster grounds and of the inability of private oyster growers to engage in the cultivation or oyster farming in State waters.

According to the detailed survey made in 1897 by Lt. F. Swift, U.S.N., there were 12,214 acres of grounds suitable for oyster culture in St. Vincent Sound, Apalachicola and St. George Sound. Although since that time some of these grounds have been destroyed, recent observations indicate that about 7000 acres of bottom may still be suitable for oyster culture. If properly attended, this area alone should produce annually 700,000 bushels of oysters, or at least 2,100,000 pounds of oyster meat. There are other areas, namely near Cedar Keys, in Tampa Bay, in Ft. Myers region, near Fernandina and in Indian River which may be developed as productive oyster bottoms.

Among the obstacles impeding the development of oyster industry in Florida, the most serious ones are an inadequate supply of shells for cultch and of seed

oysters for replanting, the destruction of oysters by drills and conchs, and the increasing domestic and industrial pollution of coastal waters. The man-made difficulties can be overcome by better management of oyster resources and by taking advantage of the favorable natural conditions which encourage prolific propagation of oysters and their rapid growth.

No success in the rehabilitation of oyster grounds may be expected, however, until the problem of controlling drills and conchs is solved and the pollution of water is checked. At present the predatory marine snails destroy the seed oysters so rapidly that the young generation of oysters is wiped out before it reaches maturity and has a chance to spawn. In the list of shellfisheries research projects the control of snails in Florida waters must be given the highest priority. Second in importance is the problem of combating and preventing the growing pollution of coastal waters.

Rehabilitation of oyster grounds is expensive, the cost varying at present from 100 to 150 dollars per acre. These expenses may be materially decreased by mechanization of harvesting and by establishing seed oyster resources near the growing or maturing grounds. Even with the most efficient methods of harvesting and having at its service best shellfish experts, the State of Florida, with the funds available at present for this purpose, can rehabilitate only a small part of depleted oyster grounds. It appears, therefore, advisable to encourage private oyster farming and invite the industry to invest the capital in the rehabilitation of oyster resources. The process can be expedited by establishing State seed oyster grounds from which seed oysters may be supplied at cost to private planters and by organizing experimental or demonstration oyster farms for further study of the best methods of oyster culture in Florida. Oyster resources of the State, now deteriorating because of neglect and lack of management, may be developed through cultivation carried out jointly by the State and private oyster growers.

TUESDAY—NOVEMBER 15

Chairman—CLARENCE P. IDYLL, Research Associate,
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An Outline For A Trinidad Shark Fishery

STEWART SPRINGER

Shark Industries Division of the Borden Company, Stuart, Florida

BY PERMISSION OF THE GOVERNMENT of Trinidad and Tobago the eighty foot motor vessel "SACHEM," owned and operated by Shark Industries Division of the Borden Company of Stuart, Florida, fished for sharks in the vicinity of Trinidad under the direction of Captain Charles Anderson for 30 days in April and May, 1949. Two sets were made within adjacent territorial waters of Venezuela by special permission through its consul at Port-of-Spain. Sets were made in the Gulf of Paria and on the north, east, and south coasts of Trinidad in depths from five to seventy-five fathoms. Each set of approximately 400 baited two and a half inch shark hooks was made with a ground line of three-eighths inch cable, about 20,000 feet long.

The catch of 750 sharks with an estimated total weight of 90 to 110 tons is not indicative of great concentration of sharks in the area. Whiteleather and Brown¹ call attention to a generally reported lower productivity of tropical waters as compared to that of higher latitudes. Sharks in the vicinity of Trinidad were found more evenly and generally distributed than in similar northern waters. Because of the apparent absence of large schools, or concentrations in limited areas, no single day's catch was very large, but the fishing results of the "SACHEM" are probably not indicative of the total shark population of the region.

Eighteen species were represented in the catch, and in addition to these, six more species are included in this report on the basis of specimens seen later, or on records in recent publications. The large number of species is unusual in so small an area, and since the range in commercial value of the various species is great, the identification of forms is important in development of shark fishery practice. This report is an attempt to provide a practical outline of the identification of species with specific suggestions for handling and utilization.

(II) SHARK PRODUCTS IN COMMERCE

Previous fishery surveys of Trinidad and Tobago and adjacent areas have carried the suggestion that a successful shark fishery might be developed if the catch in its entirety could be favorably marketed. Such a recommendation is indubitably sound and could well be extended to other fishery activities in the

1. Whiteleather, Richard T., and Brown, Herbert H., *An Experimental Fishery Survey in Trinidad, Tobago, and British Guiana*. Anglo-American Caribbean Commission. Washington, 1945: pp. 1-130.

tropics. A persistent fishery problem in any latitude is the elimination of waste; that is, waste through overfishing and exploitation of a natural resource because the value of one part of the product of fishing activity is very high, and waste because a very low market value requires the discard of other products of fishing. The liver, or rather the vitamin A in the liver, is the most valuable product of the world shark fishery, and it would be for any shark fishing operation in Trinidad and Tobago, at least under existing market conditions. The future market value of vitamin A is uncertain, not because of a probable drop in demand but because of recent success in the preparation of synthetic vitamin A. However, the effect of this is not necessarily a serious threat to the development of a successful shark fishing operation in Trinidad and Tobago.

A characteristic of the catch of the "SACHEM" was that the livers taken had a very wide range of vitamin A potency. Not only were there apparent differences in the potency range among the various species but within lots of liver segregated by species and sex. Single livers from adult sharks taken by the "SACHEM" ranged in potency from less than 500 international units to the gram of liver to more than 50,000 i.u./g liver. This condition is similar to that reported by Springer and French² for South Florida. Under such circumstances no valid conclusions concerning average liver values can be drawn. Furthermore, the catch of the "SACHEM" was made during a period of little more than a month and the effect of seasonal cycle on vitamin potency can be considerable. Oil from shark livers taken in the warm waters about Trinidad has a high stearine content and consequently is semi-solid at temperatures below 60 degrees Fahrenheit. This does not affect the usefulness of the vitamin A in it, but additional information is needed to determine the relative marketable quality of oils characteristic of the various kinds of Trinidad sharks.

Several of the larger species provide hides that have substantial value. During the rainy season there may be enough fresh water pushed into the Gulf of Paria to affect adversely the quality of shark hides taken there, but otherwise the quality should be good. Usually the presence of fresh water-damaged hides in a shipment is first detected after preliminary treatment at the tannery and may result in serious loss to the shipper. To avoid this, it is a good practice to check all hides carefully before preparation, especially those from brackish water over mud bottom. If there is a tendency for the denticles (scale-like surface covering of the hide) to slip, the hide should be discarded, or the shark should not be skinned. This slipping or looseness of the denticles is analogous to slipping in furs and indicates a spoiled spot in the hide that may render the entire hide worthless after tanning.

Although there is, at present, a greater demand in Trinidad for fresh shark meat for human consumption than is afforded by the irregular production incidental to other fishing activity, it is probable that even a small specialized shark fishery would more than satisfy it. However, distribution of fresh shark meat is restricted to the larger markets and it is recommended that an immediate objective of any Trinidad shark fishery operation be the introduction of a properly prepared, dried, salt product.

The dried fins of the larger sharks are in sufficient demand to find a ready export market, particularly since those available from Trinidad could be of better than average size and quality. It is important that fins be taken in complete sets, and for species having valuable fins it is important to include the lower tail fin.

2. Springer, Stewart and French, Price M., Vitamin A in Shark Liver Oil, *Industrial and Engineering Chemistry*; 36, 1944, p. 190.

Even with the utilization of the hides, fins, liver and meat, a considerable amount of any shark catch remains. The fins of some species, the meat of others, and the hides of small sharks are not marketable. Nearly half the weight remains after the removal of livers, fins, hides and marketable meat in most species. This residue can be made into shark meal having a protein value as high as 80 per cent. Shark meal has been shown to be satisfactory for the protein requirement of stock feed, and the supply available in Florida finds a ready market on a protein basis in competition with other sources.

There are special difficulties in grinding and drying shark waste for meal. The equipment used in the preparation of fish meal does not in all cases handle shark in a satisfactory way. There are important reasons for an attempt to find a solution to the problem of preparation of shark meal in Trinidad. The idea that shark carcasses and shark wastes spoil fishing when dumped on the fishing grounds over a long period of time is prevalent among fishermen. The problem of disposal of waste by a shore station is a serious one and can become a major operating expense. But perhaps the best reason for the preparation of shark meal in Trinidad is that the requirements for protein ingredients of stock feed now have to be met by importation and locally produced shark meal would go far to meet this demand. It is recommended that any program for a shark fishery in Trinidad include the examination of the possibilities for the preparation of shark meal using equipment adaptable to drying other available production wastes which can be used in animal feed.

(III) SHARK PRODUCTION IN TRINIDAD

Direct transfer of fully equipped fishing boats successful in other latitudes is not the only method for improving the productivity of Trinidad and Tobago marine fisheries. Increased production should follow persistent effort directed toward the correction of several conditions that now impede the progress of the fishery. One of the important bars to better production is the large degree of standardization in methods, gear, and boats. Along with this condition there is little boldness in the use of boats, in the risk of gear, or in trial of the unfamiliar. Improvement of production is to be sought by trial and error in the adaptation of knowledge about fishing and seamanship to particular local conditions. This implies instruction to fishermen but it is important that the instructor be a practical student of local fishing conditions and that the object of increasing today's production be constantly in view.

In long range, the progress of the Trinidad and Tobago fishery is held back by the standardization of small boat building to one type, by inadequate repair facilities for fishing boats of intermediate size, and by lack of protected moorings for boats too large to beach.

For the development of a shark fishery in Trinidad it is doubtful that a method such as that of the "SACHEM" is a proper aim, because the use of offshore equipment precludes the utilization of any by-products. A shark fishery similar to that of Cuba, in the employment of small rigs and wide usage of production, appears to be more adaptable to local conditions.

There is now in Trinidad an especially favorable marketing condition for shark products, and the problem of initiating production does not appear too formidable. A shark fishery offers unusual benefits to Trinidad because it would furnish an exportable surplus of vitamin A bearing liver, of fins, and of raw hides, because it could be made to meet urgent needs for low cost protein for human consumption and for animal feeds, and because its principal costs are for

labor rather than materials. On the other hand, it requires in its development a large amount of persistent and determined effort.

It is recommended that buoyed handlines, short setlines, and light weight, small set-nets be used for catching sharks. Somewhat larger boats than at present available to the average Trinidad fisherman would be desirable to get production at some distance from base, but determined men can make substantial catches close to the long coastlines of Trinidad and Tobago with boats now in use for fishing. It is probable that shark fishing close in shore would be more successful during the night.

(IV) SHARKS OF TRINIDAD

In the late spring the "SACHEM" fishing showed the bull shark to be the most valuable of the Trinidad species. At this time also the small black-tip, the great hammerhead, the South American hammerhead, and the market shark were present in the Gulf of Paria and would be the most valuable species to Trinidad fishery. It is probable that some of the other species would be found to be of relatively greater importance at other times of the year.

1. SAND-TIGER. *Carcharias taurus* Rafinesque.

This shark was not taken but is included because it has been taken both north and south of the latitude of Trinidad. It is a large (adults are 8 to 10 feet long), ugly shark and may be distinguished from other sharks of the region by the teeth, which are long, slender, and sinuous and have small hooks or toothlets at the bases of the larger ones. The hides and fins are worthless and in known examples the liver potency is very low.

2. MAKO. *Isurus oxyrinchus* Rafinesque.

This is an offshore species not taken by the "SACHEM" but included here because of a previous report of its capture off the coast of British Guiana. It may be easily distinguished from other Trinidad sharks because it has in combination, lateral keels or ridges at the base of the tail, a sharp pointed snout, long sinuous awl-like teeth without serration and without hooklets on their bases. The hides and fins have no value. The value of the liver oil is unknown. The meat of this species in other localities is considered very good.

3. NURSE SHARK. *Ginglymostoma cirratum* (Bonnaterre).

The nurse shark is radically different from other sharks, the smooth tan hide (not sandpaper-like to the touch as in other sharks), the presence of barbels, and the paved teeth set it apart from other Trinidad species. Full grown nurse sharks are 7 to 9 feet long. It appears to be generally distributed in shallow water around Trinidad but more abundant on the north and east coasts and around Tobago. It frequents rocky and coral bottom. The hide is more valuable than that of any other shark, the fins are worthless, and the liver oil is usually of very low potency. Although I am told that the meat is rejected by the Port-of-Spain market it is in my opinion superior to that of most other sharks. The nurse shark is a harmless species insofar as its armament is concerned but it is one of the most troublesome sharks to handle. Large ones should not be taken into a small boat alive. They may be killed by a knife thrust into the back of the head so as to sever the vertebral column.

4. WHALE SHARK. *Rhincodon typus* Smith

This shark has not been recorded from Trinidad but it is likely that it is occasionally present. It is a harmless plankton feeder but too large for a small boat to tackle safely. It is too rare to have any commercial value.

Regular distribution of whitish spots in rows and ridged surfaces make it resemble some riveted metal fabrication of man, and its sudden appearance alongside a small boat is alarming, if not dangerous.

5. SMOOTH HOUND. *Mustelus canis* (Mitchell).

This small three or four foot shark with blunt, paved teeth was not taken by the "SACHEM" but has been mentioned in previous reports. In other localities the species has little commercial value.

6. TIGER SHARK. *Galeocerdo cuvier*. (Lesueur).

The tiger shark is the common big shark of Trinidad and Tobago. It reaches maturity at about 9 feet 6 inches with weights of adults often in excess of 500 lbs. The largest tiger taken by the "SACHEM" was 12 feet 9 inches long and had a liver weighing 240 lbs. Tiger sharks may be recognized by the presence of strong reinforcing ridges along the sides of the base of the tail in combination with a blunt, truncate snout and wide-based large teeth, similar in the upper and lower jaws. Young tiger sharks are spotted and striped above with black or lighter ground color. As the shark gets older the spots become more diffuse and tend to form stripes. In full grown examples the stripes may disappear altogether. Four adult tiger sharks taken by the "SACHEM" off the east coast of Trinidad were representative of a black phase of biological interest. All of these sharks were a uniform shiny black above, contrasting sharply with immaculate white below. Two of them, adult males, were otherwise of normal appearance and proportion, but two, a male and a female, were much shortened in the tail region. The female, 8 feet 6 inches long, had size and proportions of head and fins approximately the same as that of the normal tiger shark 11 feet 2 inches long taken at the same time. The black phase is said to be common about Tobago. The tiger shark is common everywhere around Trinidad but not in large schools. The hides and fins are of good quality and although the liver oil potency is low, the amount of liver is usually large and the oil content is often as high as 75 per cent. The fresh meat is somewhat bitter and not marketable.

7. LEMON SHARK. *Negaprion brevirostris* (Poey).

Our specimens of this species were three adult females and two adult males 7 feet 6 inches to 8 feet 6 inches long, taken on the east coast of Trinidad. The females had pups 23 to 24 inches long and these all swam away in apparent good condition when thrown overboard after being liberated from the oviducts of the mother. The lemon shark is characterized by having a large second dorsal fin in combination with a broadly rounded blunt snout. It prefers shallow water away from mud and brackish conditions and it is likely that the species is relatively more abundant around Tobago than Trinidad. The hides, fins and meat are of good quality. The liver oil potency is generally low except in adult males.

8. BLACK-NOSED SHARK. *Carcharhinus acronotus* (Poey)

The black-nosed shark reaches an extreme length of little more than 4 feet. It may be always recognized by the presence of a black spot or indistinct smudge of black on the tip of the snout. Our specimens were from the east coast of Trinidad. Although the meat of this shark is good, the hides and fins are too small for use, and the liver oil potency is low.

9. BULL SHARK. *Carcharhinus leucas* (Müller and Henle).

This would probably be the most valuable shark of any shore-based shark fishery in Trinidad. It is a species of moderate length, the males

in the Trinidad area reaching maturity at about 6 feet 6 inches. The females are slightly larger but the maximum length of the species as represented by our Trinidad specimens is a little less than 9 feet. The bull shark is heavy for its length and specimens weighing 400 lbs. or more are not rare. The bull shark resembles other species of *Eulamia* and *Carcharhinus* in general aspect, and for identification it is necessary first to determine whether or not a ridge is present in the skin between the first and second dorsal fins. If there is no trace of a ridge and if the shark is five feet long or more and if at least a few of the teeth in the central part of the upper jaw are roughly triangular and not deeply notched on both sides, the shark is very likely a bull shark. Bull sharks are generally shallow water sharks that frequent brackish water. They were taken by the "SACHEM" all around Trinidad but in greater quantity on the south coast. The hides are good unless ruined by fresh water and the fins and meat have a good market value. Liver potencies of specimens taken in the Trinidad area were relatively high but in this there appears to be an extremely wide range of variation.

10. MARKET SHARK. *Carcharhinus porosus* Ranzani.

Common names of sharks in Spanish are applied so indiscriminately that one species may have a dozen different names in use in different localities. English common names have a somewhat wider basis. Since *Carcharhinus porosus* does not have an English common name I take the liberty of calling it market shark, an appropriate name in Trinidad at least. The species reaches a length of little more than 3 feet and is the commonest shark in the Gulf of Paria. It has no ridge between the dorsal fins and no dark markings or spots. Large numbers are sold on the Trinidad market but the hides and fins are too small to have any value. The liver oil is sometimes relatively high in vitamin A but the livers are small and the percentage of oil in them is low.

11. SMALL BLACK-TIP SHARK. *Carcharhinus limbatus* (Müller and Henle).

Males of this species become mature at a length of not much less than 4 feet 6 inches and very few individuals of either sex exceed 6 feet. The shark is well marked by black tips on many of the fins. Black-tips were taken frequently by the "SACHEM" in the Gulf of Paria and in the Serpent's Mouth. A few were collected on the north and on the east coasts. Since the small black-tip is common and easily taken it is one of the more valuable species around Trinidad. The hides are thin and not large and the fins are of much lower value than those of larger sharks but the meat is marketable and the liver in Trinidad specimens is rich in vitamin A.

12. LARGE BLACK-TIP SHARK. *Carcharhinus maculipinnis* (Poey).

One specimen was taken by the "SACHEM" off the north coast of Trinidad. Large black-tips reach a length of 8 feet or just a little more, and males become mature at not much less than 5 feet 6 inches. The teeth on the lower jaw are smooth on the edges rather than finely serrate as in the small black-tip. However, this is a characteristic that cannot always be checked unless a microscope is available. A more convenient way to distinguish between the two is to view the lower jaw teeth from the sides. In the small black-tip the cusps are somewhat sinuous and the tips curve slightly outward. In the large black-tip these teeth are neither sinuous nor recurved. A further difference, if both species are available for comparison,

is that the large black-tip has smaller teeth in spite of the greater size of the shark.

13. ——— *Isogomphodon oxyrhynchus* (Müller and Henle).

This shark was described originally in 1841 from an 18 inch specimen from Surinam, and is known only from that description and a few museum specimens in poor condition. It has been twice recorded from Trinidad.^{3 4} On the first day of Trinidad fishing on the north coast one small specimen was taken but was lost before detailed examination could be made. Probably the specimen was this species because it was noticed that it had many rows of small sharp teeth. There was no fin markings. No other specimens were seen.

14. SHARP-NOSED SHARK. *Scoliodon lalandii* (Müller and Henle).

These are common small sharks rarely reaching more than 3 feet in length. The species has little value except as a market fish. Sharp-nosed sharks may be distinguished from others in Trinidad region by their size and by the presence of grooves in the skin which originate at the corners of the mouth and run along the sides of the jaw. The Trinidad form has been identified as *S. lalandii* rather than *Scoliodon terra-novae* (Richardson) because the specimens taken by the "SACHEM" appear to represent a population of smaller sharks than *terra-novae* of the Northern Caribbean and Gulf of Mexico and because embryos (at 5 inch length) of Trinidad specimens have a dense growth of long and thread-like villi on the pseudo-placental attachment tube, a phenomenon not yet observed for embryos of *terra-novae*.

The RIDGE-BACK SHARKS. *Eulamia*.

Along the east coast of the United States these are called "Ground Sharks," in Australia they are "Whaler Sharks," on the east coast of Florida they are often called "Mackerel Sharks," on the west coast of Florida they are called "Mullet Sharks," and so on. They are very common in all temperate and tropical seas and there are many species that are distinctly set off from one another by differences of habit and habitat. They generally move in schools, frequently appearing in great numbers. The ridge-back *Eulamia* were represented in the catch of the "SACHEM" by five species. These are similar to one another in general structure and are difficult to identify. Knowledge of the group is still insufficient to provide a stable classification. All of them are valuable for hides and fins, and, so far as is known, for marketable meat. The livers of Trinidad specimens taken by the "SACHEM" were relatively high in vitamin A potency except for *Eulamia altima*, a species apparently producing low potency liver throughout its range.

15. KNOPP'S SHARK. *Eulamia altima* Springer

This shark is restricted to depths of 50 to 200 fathoms, and so far as known only strays a short distance from these depths at night when it may appear at the surface or on the shallower bottoms near deep water. As would be expected, the catches of a dozen or more adults taken by the "SACHEM" came from the deep water in the Dragon's Mouth. Adults are within a length range of 7 to 9 feet and differ from other ridge-backs in having somewhat longer and thicker snouts with wider, more prominent depressed channels or nasal scoops, in having dermal denticles not over-

3. Vincent, Sea Fish. Trinidad 1910.

4. Fowler, Proc. Acad. Nat. Sci. Phila. 67 : 1916, p. 521.

lapping and about half the size of those of the closely allied *E. plumbeus* and *E. milberti*, and in having the large central teeth of the upper jaw higher and exactly triangular without lateral notches. The only notable difference of Trinidad specimens from those found off Florida was that the Dragon's Mouth sharks were very much less resistant to the knife, a phenomenon apparently associated with the characteristics and amount of mineral deposits laid down around the cartilages.

16. REEF SHARK. *Eulamia falciformis* (Müller and Henle).

Several reef sharks were collected by the "SACHEM" off the east coast of Trinidad. The species prefers the vicinity of coral reefs and the edges of oceanic banks. At times it is found at the surface in large schools. It may be expected to be relatively more common around Tobago than Trinidad. The fins of the reef shark, particularly the pectoral fins, are thinner and appreciably lighter in weight than in other ridge backs. Adults are in the size range from 5 feet 6 inches to 8 feet long and the young are relatively large at birth. Unfortunately the name *E. falciformis* as now known, probably covers two species. In Trinidad specimens, the upper jaw teeth are very strongly notched on both margins and the cusps are much narrower than in related ridge-backs.

17. DUSKY SHARK. *Eulamia obscurus* (Lesueur).

Adult dusky sharks are mature at a little more than 9 feet long and reach a length of more than 11 feet. These sharks appear to be fairly common off Trinidad in moderate depths. The only one taken by the "SACHEM" within territorial waters came from the north coast. Like the reef shark, there are apparently two forms of the dusky shark.

18. SILKY SHARK. *Eulamia floridanus* Bigelow, Schroeder and Springer.

Silky sharks are 7 to 10 feet 6 inches as adults and are generally sharks of blue water. No specimens were taken by the "SACHEM" within territorial waters of Trinidad but several were secured from off the coast of British Guiana. The silky shark is an active powerful shark with a more slender and trim appearance than other ridge-backs. The denticles are small and the hide often has a silky appearance. It is more pelagic than other ridge-backs and frequently appears at the surface although it is sometimes common in depths of more than 100 fathoms.

19. SAND-BAR SHARK. *Eulamia plumbeus* (Nardo).

Trinidad sand bar sharks differ from the sand-bar sharks of Florida, *Eulamia milberti*, in habits and in having heavier denticles set closer together. *Eulamia plumbeus* is the name properly applied to sand-bar sharks of the eastern Atlantic and Mediterranean and is tentatively used for the Trinidad form although additional information is needed to verify the identity of the Trinidad and eastern Atlantic species. The north coast of Trinidad is a nursery ground for the sand-bar shark and specimens of sizes from 30 inches up to 7 feet 6 inches long were taken. The species does not reach a length of as much as 8 feet.

20. BONNET-HEAD SHARK. *Sphyrna tiburo* (Linnaeus).

The bonnet-head shark reaches a length of about 3 feet and is very likely common in the Gulf of Paria in shallow water. Although no specimen of this kind was taken by the "SACHEM" a specimen was seen in the market and it has been reported as being common in Trinidad. It may be recognized by its spade-shaped head that has no indentation in its marginal outline at the nasal apertures, but is not regularly oval as in *S. media*.

The bonnet-head is in demand on the Port-of-Spain market but it is too small to have much value otherwise.

21. SCOOP-HEAD SHARK. *Sphyrna media* Springer.

This form is only a little larger than the preceding and probably does not greatly exceed 4 feet in length. It was described from Pacific specimens and this is the first positive record of its occurrence in the Atlantic. Two adult females were taken by the "SACHEM" in the Gulf of Paria. One of these contained eight 4 inch embryos. It is probably too small and uncommon to be of any commercial importance.

22. GREAT HAMMERHEAD. *Sphyrna tudes* (Valenciennes).

The several great hammerheads taken by the "SACHEM" ranged from 9 feet to 12 feet 6 inches long. Some specimens of this species have been taken in other localities as large as 15 feet or more. The great hammerhead has a wide but very shallow groove in the front margin of its head running from the nasal aperture toward the center of the head. In other hammerheads this groove is narrow, deep, and slit-like. The liver of the species usually produces high potency oil and the fins are valuable. The hides are valuable if in good condition but are thin and are somewhat difficult to prepare in first-class condition. The meat of all the hammerheads appears to be in demand on the Port-of-Spain market. These large hammerheads are very powerful and large individuals are too much for small boats and light gear. However, hammerheads die quickly when their free movements are restrained and if properly handled can be killed with relatively light tackle. They usually die within an hour if entangled in even a light net.

23. COMMON HAMMERHEAD. *Sphyrna diplana* Springer.

The common hammerhead *Sphyrna zygaena* (Linnaeus) frequents the higher latitudes at least to the north and in the western Atlantic. I have not been able to verify a record of its occurrence south of Salerno, Florida, where it is occasionally taken as a straggler in schools with *S. diplana*. One specimen of *diplana* was collected off the north coast of Trinidad. This species differs from other hammerheads of Trinidad in having a very low second dorsal fin with a long slender posterior lobe, its length more than twice as great as the height of the fin. *S. diplana* reaches a length of 10 feet or a little more and is not mature at less than 6 feet 6 inches.

24. SOUTH AMERICAN HAMMERHEAD. *Sphyrna bigelowi* Springer.

The second dorsal fin of this species is somewhat higher than in *S. diplana* and the form does not reach such a large size. The smallest adult male taken by the "SACHEM" was 5 feet 6 inches long and the largest 6 feet 6 inches long. However, fewer than a dozen specimens, all males were taken. Most of these were caught in the Gulf of Paria.

(V) IDENTIFICATION OUTLINE. ⁵

1. Sharks with expanded, flattened heads; hammerheads and shovel-nosed sharks.

A. Head hammer shaped, its front margin lobed or scalloped.

a. Groove in front margin of head shallow; second dorsal fin

high *Sphyrna tudes*

5. It is suggested that identification of species be undertaken with the aid of the well illustrated "Guide to Commercial Shark Fishing," Anglo-American Caribbean Commission, Washington, 1944, or better, with "Fishes of the Western North Atlantic" vol. 1, article 3, The Sharks, by Bigelow and Schroeder, Wm. Sears Foundation for Oceanography, New Haven, 1948.

- b. Groove deep; second dorsal fin low *Sphyrna diplana*
 - c. Groove deep; second dorsal fin intermediate *Sphyrna bigelowi*
- B. Head evenly rounded or spade-shaped, not lobed or indented.
 - a. Head oval, not at all pointed in front *Sphyrna media*
 - b. Head spade-shaped *Sphyrna tiburo*
- 2. Sharks with keels along each side of the base of the tail.
 - a. Teeth large, wide, with saw-like edges *Galeocerdo cuvier*
 - b. Teeth narrow, sinuous, lance-like *Isurus oxyrinchus*
 - c. Teeth very small, enormous sharks with terminal mouths *Rhincodon typus*
- 3. Sharks with low, blunt, paved teeth.
 - a. Hide smooth when rubbed in direction toward the head *Ginglymostoma cirratum*
 - b. Hide sand-paper like when rubbed toward the head . . *Mustelus canis*
- 4. Sharks not as in 1, 2, or 3, but with second dorsal fins with area as great or greater than one-half the area of the first dorsal.
 - a. Teeth not serrate, long, narrow and sinuous, with a small hook or toothlet at the base on either side; snout pointed *Carcharias taurus*
 - b. Teeth not serrate, cusps narrow, somewhat flattened, without toothlets; snout broadly rounded *Negaprion brevirostris*
 - c. Teeth serrate on cusps; snout pointed; second dorsal about half as large as first dorsal *Isogomphodon oxyrinchus*
- 5. Small sharks not as above but with two grooves on either side originating at the corners of the mouth and extending nearly parallel to the mouth for a distance about equal to the diameter of the eye *Scoliodon lalandii*
- 6. Sharks without special structures as under 1, 2, 3, 4 and 5. Typical sharks.
 - A. A ridge in the skin between the first and second dorsal fins.
 - a. Denticles not imbricate, deep water sharks, 7 to 9 feet as adults *Eulamia altima*
 - b. Denticles not imbricate, 6 to 8 feet long as adults *Eulamia plumbeus*
 - c. Denticles imbricate, 5 to 8 feet long as adults, narrow tooth cusps *Eulamia falciformis*
 - d. Denticles imbricate, 9 to 11 feet long as adults . . . *Eulamia obscurus*
 - e. Denticles imbricate, 8 to 10 feet long as adults . . . *Eulamia floridanus*
 - B. No trace of a ridge in the skin between the dorsal fins.
 - 1. Teeth of upper jaw with narrow cusps on broad bases.
 - a. Lower jaw teeth serrate, tips recurved outward, fins black-tipped *Carcharhinus limbatus*
 - b. Lower jaw teeth smooth, tips not recurved, fins black-tipped *Carcharhinus maculipinnus*
 - c. Fins not black-tipped *Isogomphodon oxyrinchus*
 - 2. Teeth of upper jaw flattened somewhat triangular.
 - a. Tip of nose with a black smudge, small sharks *Carcharhinus acronotus*
 - b. No black-tip on nose, small sharks, under 4 feet *Carcharhinus porosus*
 - c. Larger sharks, adults over 6 feet long *Carcharhinus leucas*

The Commercial And Game Fishing Industries Of Bermuda

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THE TOTAL REEF area of Bermuda inside the 100-fathom curve is approximately 400 square miles, exclusive of two off-lying banks 10 and 18 miles from shore. The area of each of these 30 fathom banks is about 50 sq. mi. In all, there is a maximum area of 500 square miles from which to keep continuously supplied with sea food the requirements of a resident population of 42,000, and a transient tourist trade of 60,000 a year.

The supply of fish has never been able to meet the demand, though the almost complete lack of coordination between the catch and its distribution is at least partially to blame for this. Other factors, which will be listed later, also have a direct relationship to this deficiency.

To supplement the local catch, 36,500 lbs. of fresh, 377,000 lbs. of salted and 77,000 lbs. of smoked fish were imported during 1948.

The commercial fishing industry of Bermuda is hardly worthy of the name. There are slightly less than 100 men engaged on a full time basis in fishing, and fifty-five boats comprise the entire fleet.

As there is no marketing center, the more enterprising individuals have a contract for their catch direct with one or more hotels or guest houses, a meat market or one of the United States bases. It is in this connection that the Government may well assist the industry.

Fishermen who operate on a very small scale generally dispose of their catch at the dockside, and there is never a lack of customers. The fish is invariably fresh, due mainly to the fact that most boats are fitted with live wells and that nearly all ply their trade within about two hours' run from the docks.

The fish are sold flayed or scaled, and gutted, to both the wholesale and retail trade. The wholesale price averages one shilling and sixpence (21c. U.S.) and the meat markets retail it at around two shillings per pound. The price per pound at the boats is two shillings in the city areas (28c. U.S.) and in the isolated parts it is a sixpence or so less.

It has always been the opinion of the writer that a Government owned and operated quick freezing plant, built primarily for the use of the fishing trade, would be an excellent investment in the economy of the Colony, and in times of emergency would serve as an added place of storage for meats. This would be a great stimulant to the fishing industry, and would enable the fishermen to build up a reserve during the summer months to take care of some of their losses in winter.

Those interested in improving the lot of the fisherman are hoping that the present Legislature will agree to provide adequate quick freezing facilities. The Fisheries Committee of the Board of Trade has already recommended this.

In general, fish in Bermuda fall under two categories. Such species as grouper, rockfish, mangrove and red snapper, hind, porgy, bream, grunts, margate-fish, hogfish, yellowtail, etc., are classified locally as "bottom fish," while the two species of amberjack, mackerel, bonito, tuna, and jacks, etc., are known as "floating fish." The term "floating" indicates that these fish are always caught at or near the surface. The former are invariably caught by fish pot or hand line, while the latter are taken by seine or hand line. Trolling is seldom

indulged in by commercial men as a principal method of making their catch, though many of them hang a line over the stern with an artificial lure while running to and from their pots or fishing spots. Trolling is a phase which could definitely improve the catch seasonally, especially when tuna and wahoo are biting well.

The total annual catch of fish, by all methods, averages about 900,000 pounds in weight each year. The lobster catch is approximately 50,000 lobsters, averaging around 160,000 pounds in weight each year. The estimated total value of the combined catch is £78,000 (\$312,000 before devaluation). In spite of the comparatively small total catch, at least two of the fishermen have been able to average about £2,000 net from their efforts over the past few years.

There is no incentive to encourage anyone to enter the fishing trade in Bermuda. The only concession which is made to the fishermen is one of little consequence, and that is the fact that they are permitted to buy gasoline, of an inferior quality, at sixpence less per gallon than it is sold to the motor vehicle trade at the filling stations. The present price per gallon is two shillings and seven pence (37c U.S.) to the fishing boats.

Following is a list of the fish of greatest commercial value in Bermuda waters. Common names are followed by their scientific designation in order that there will be no confusion as to the actual species referred to:

Grouper or Hamlet
Epinephelus striatus
 Rockfish
Mycteroperca bonaci
 Hind
Epinephelus maculosus
 Red Grouper
Epinephelus morio
 Amberfish
Seriola lalandi
 Madregal Bonito
Seriola falcata
 Horse-eye Bonito
Seriola dumerili
 Yellowtail
Ocyurus chrysurus
 Gray Snapper
Lutianus griseus
 Red Snapper
Lutianus aya, buccanella,
campechanus, etc.
 Spot Snappers
Lutianus synagris
 Hog Fish
Lachnolaimus maximus
 Margate-fish
Haemulon album
 Blue-striped Grunt
Haemulon sciurus
 Bream
Diplodus argenteus
 Barracuda
Sphyræna barracuda
 Sennet
Sphyræna picudilla
 Gwelly
Caranx guara
 Blue Runner
Caranx crysos

Whale Jack
Caranx latus
 Turbot Trigger-fish
Balistes carolinus
 Blue Angel-fish
Angelichthys isabelita
 Gag
Mycteroperca tigris
 Monkey
Mycteroperca falcata
 Red Rockfish
Mycteroperca venenosa apua
 Black Grouper
Garrupa nigrita
 Guinea Chick Grouper
Epinephelus drummondhayi
 Porgy
Calamus bajonado
 Mackerel
Euthynnus alleteratus
 Mackerel
Auxis thazard
 Big-eyed Tuna
Parathunnus atlanticus
 Yellow-fin or Allison Tuna
Neothunnus allisoni
 Oceanic Bonito
Katsuwonus pelamis
 Wahoo
Acanthocybium solandri
 Pompano
Trachinotus palometa
 Gar-fish
Hemiramphus brasiliensis
 Bermuda Chub
Kyphosus sectatrix
 Mullet
Mugil cephalus
 Parrot-fish
Sparisoma scarus, pseudoscarus

Besides the foregoing there are several other species occasionally brought in by the commercial fishermen. Dolphin, jewfish and tapioca or oil-fish are not infrequently found. The two latter are almost invariably caught at

night, and in deep water while fishing for red snappers. Dolphin are purely surface fish and are usually only caught when trolling, a form of fishing seldom indulged in by the commercial industry. The jewfish is the same as that taken in Florida and along the coastline of the Gulf of Mexico, where it is usually found in very shallow water.

Following are some statistics concerning the annual catch. The figures are estimates only, as there are no regulations requiring an annual catch return being filed by the fishermen. The method of arriving at the estimate is purely one of average, but it is believed to be within 10 per cent of the actual catch. As few of the men keep within records, the estimate is based on average number of trips per week in both summer and winter months, and the average catch per trip in pounds weight.

Number of men employed full time in fishing	100
Number of boats employed full time in fishing	55
Estimated catch of fish 1948 (an average year)	900,000 lbs.
Estimated catch of lobster 1948 (an average year) ...	160,000 "
Estimated total value to the industry of the combined catch of fish and lobster	£78,000
Average value of annual turtle catch	£ 250
Average wholesale price of fish	1/6 per lb.
Average wholesale price of lobster	1/3 " "
Price of turtle, retail, dressed	3/6 " "

Sea food imported into Bermuda in the year 1948 to supplement the annual catch. Figures supplied through the courtesy of the Collector of Customs, Bermuda.

Fish (canned or bottled)		£20,212
Fish, Cod (salted)	377,076 lbs.	16,770
Fish, fresh	36,367 "	3,449
Fish (shell)	24,053 "	4,666
Fish (smoked or pickled)	76,870 "	4,857
	514,366 lbs.	£49,914

Oysters, clams, conchs and crabs are not found in commercial quantities in Bermuda, and, therefore, have no bearing on the trade. Perhaps half a dozen individuals make a part time living from the gathering of mussels (*Arca occidentalis*) which fetch a current price of four shillings per quart removed from the shell. Until twenty years ago the scallop (*Pecten ziczac*) played an important part in the sea food trade, but for some undetermined reason they have become almost extinct. Rigid protective laws, in force before any undue shortage was noted, failed to have any effect on their preservation. They are so rare on the market at present that they command a price of ten shillings a dozen when available. The almost complete lack of mangroves makes the cultivation of the mangrove oyster impracticable.

GAME FISHING

Game fishing in Bermuda has had many set-backs since its commencement in 1934. The trade was just about getting in its stride in the summer of 1939 when the advent of World War II terminated all sport fishing activity abruptly.

Following is a list of fish which are considered to be of importance to the sport fishing industry of Bermuda. The common names are those used locally. The fish called amberfish is the same as amberjack elsewhere, and one known here as bonito has no relation to the bonito of the U.S., it being a species of amberjack—the madregal. The common bonito is known locally as mackerel.

Blue Marlin
Makaira ampla
White marlin
Makaira albid

Black marlin
Makaira bermudae
Wahoo
Acanthocybium solandri

Oceanic bonito
Katsuwonus pelamis
 Mackerel or Little tunny
Euthynnus alletteratus
 Big-eyed tuna
Parathunnus atlanticus
 Allison tuna
Neothunnus allisoni
 Yellow-fin
Neothunnus albacora
 Albacore (rare)
Germo alalunga
 Bonito
Sarda sarda
 Hogfish
Lachnolaimus maximus
 Bream
Diplodus argenteus
 Amberfish
Seriola lalandi
 Horse-eye
Seriola dumerili
 Madregal
Seriola falcata

Chub
Kyphosus sectatrix
 Bonefish
Albula vulpes
 Pompano
Trachinotus palometa
 Dolphin
Coryphaena hippurus
 Barracuda
Sphyræna barracuda
 Sennet
Sphyræna picudilla
 Jacks
Caranx sp. 4
 Yellowtail
Ocyurus chrysurus
 Gray Snapper
Lutianus griseus
 Porgy
Calamus bajonado
 Rockfish
Mycteroperca bonaci

Specimens of amberjack have been caught weighing over 170 lbs., and rockfish up to 180 lbs.

Repetition of Egg-Laying and Number of Eggs of the Bermuda Spiny Lobster¹.

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DURING THE SUMMER MONTHS of 1949 the writer at the Bermuda Biological Station engaged in a study of the egg laying habits of the Bermuda Spiny Lobster, *Panulirus argus* (Latreille) 1804. This study has revealed some interesting features in numbers of eggs and repetition of laying which have not been recorded for this species in other locations.

Female specimens were tagged with a wire and lead plate fastened to a joint of the antennae. Others were tagged with a plastic tag thrust between the abdominal segments.

Considerable evidence was obtained by these tagging methods on the repetition of laying eggs in this species.

This evidence may be summarized as follows:

1. Tagged specimens known to have laid once in the laboratory tanks repeated the egg laying performance.

2. Females with pleopods recently shed of eggs (as shown by the condition of the pleopods and egg shell fragments) were tagged and released and later recaptured with a new batch of eggs.

3. Females which had laid eggs at least once, in the laboratory showed a condition in which either the ovaries were completely filled with eggs or were entirely spent.

4. A female known to have laid eggs twice, had the ovary entirely spent.

5. The second laying of eggs (at least the second) is considerably reduced in amount and the posterior pleopods are not completely filled.

1. This study has been made possible by the writer's affiliation with the Bermuda Biological Station as summer resident biologist, and with the Biology Department of Hofstra College, Hempstead, Long Island, N. Y.

6. Females captured late in the egg-laying season frequently carry the reduced number of eggs. The waxy substance on the annulus ventralis, believed to be the spermatophore, is almost completely expended at the time of the second laying.

The number of eggs deposited by the Spiny Lobster *Panulirus argus* (Latreille) 1804 has been previously estimated by other scientists. Crawford and De Smidt (1922 p. 307) have estimated that a female with a carapace length of 3½ inches (about 10 inches total length) carried an estimated 500,000 eggs. Those having a 4 inch carapace length laid an estimated 700,000 eggs. Such a specimen would be about 11½ inches in total length. These results were obtained from Southern Florida specimens. Smith (1948, p. 15) states that the number varies with the size of the animal and that a 9 inch specimen laid about 500,000 eggs. These also were computations on Florida and Caribbean specimens.

My results on the Bermuda race of lobster vary from the condition stated above. Computations were made by counting the eggs in one gram (9988 eggs) and multiplying this by the total weight.

A spiny lobster 10 inches long produced 669,196 eggs at one laying. Another, 12 inches long, laid 1,118,656 and a third, 15 inches long, laid 2,566,916 eggs. A 13 inch female tagged spiny lobster known to have laid at least once, produced 1,008,788 eggs on the repetition or second laying, the number being less than at the first laying.

On the basis of the foregoing it would appear that a 15 inch female might lay in excess of 4,000,000 eggs in one season.

The smallest female observed carrying eggs was 9 inches long. During the trapping operations in July virtually all females of varied sizes carried eggs. This seemingly indicates that the females lay eggs annually instead of every other year as has been suggested by some students of the species.

The number of eggs produced by the various length groups has a direct bearing upon the conservation of the species. A conservation measure which would save one 15 inch female would be equivalent to saving four 10 inch specimens.

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The Marine Fisheries Of The Caribbean

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INTRODUCTION

IT IS THE INTENTION of this paper to give a general picture of the marine fisheries of the Caribbean region. Attention is focused on the islands of the Caribbean (the Greater and Lesser Antilles), the territories of Central America, and the countries of South America bordering in the Caribbean Sea. The infor-

mation contained herein is based on published reports and information collected by staff members of the Fisheries Division of FAO. Most of the published material appears in papers of the United States Fish and Wildlife Service and the Development and Welfare Reports of the British West Indies.

The Gulf and Caribbean Fisheries Institute is concerned with the fisheries of the Gulf of Mexico and the Caribbean Sea. The two regions are characterized by differences in conditions of productivity. What is more important, their fishing industries are in different stages of development by reason of the wider use of mechanized equipment in the Gulf of Mexico. Problems faced by the two regions are not the same. Discussion here is confined to the Caribbean, the lesser developed of the two.

Prior to World War II, large quantities of fishery products, chiefly salt cod, were imported by countries of the Caribbean. During the war, as the result of shortages of shipping, unavailable European supplies, diversion of North American exports and reduced European production, imports fell off sharply. It was evident then that local production of foodstuffs was of great necessity. A great interest in the further development of their aquatic resources was manifested by these countries and this has continued in postwar years. Assistance was received from the agencies of the United States Government and the British Colonial Service in the form of rapid fact-finding surveys of the fisheries and the fishery resources. More recently, the Food and Agriculture Organization of the United Nations, or FAO as it is familiarly known, has been requested by some member governments to assist in surveys and in planning fisheries development.

Any improvement in the utilization of the fisheries resources in this region will be a further step toward increasing world food production. It will also improve the local diets which are often deficient in proteins and will offer new industries and additional employment.

FISHERIES RESOURCES

Oceanography of the Area

Tropical and sub-tropical waters are not generally considered to be as productive as those of temperate regions. However, much remains to be learned in this connection. It appears that the concentration of nutrient salts, particularly nitrates and phosphates in the upper or photosynthetic layer, limits production of phytoplankton. These microscopic plants are the basic link in the food chain of all living organisms of the sea. Surface layers may be replenished with dissolved nutrient salts, by annual convection overturns, which return rich lower waters to the surface, ocean currents, upwellings, and river waters.

The Caribbean Sea, like the Mediterranean, consists of a number of more or less independent deep basins. The Caribbean consists of two deep basins with half the total area having depths of 2,000 fathoms or more and about four-fifths deeper than 1,000 fathoms. Fiedler et al. (1947) state that there is no regular overturn and that the water in the basins is static and stable. The flow of water into the Caribbean is restricted. Water from the Atlantic must flow through the narrow and shallow (in comparison with the Caribbean itself) passages of the Antilles. There are no great rivers flowing into the sea. Supplies of nutrient salts are obtained principally from the South Equatorial Current which sweeps along the coast of Brazil and the Guianas, picking up rich water from the outpourings of the great rivers of this region. It flows into the Caribbean

bean mainly through the channel between Trinidad and Tobago and continues along the coast of Venezuela, making this area of the sea productive. However, on reaching the central and western region of the Caribbean, its productivity decreases.

The continental shelf with depths of 100 fathoms or less is restricted to narrow coastal strips and small offshore banks. This limits the area available inshore for demersal species. Traditionally, the world's greatest fisheries have been carried on within the limits of the continental shelf.

Commercial Species

Species taken in the inshore waters include bottom fishes and also some pelagic species during certain times of the year. It is likely that the main populations of the latter are not within reach of the present fishing operations.

As is typical of tropical and sub-tropical waters, there are a multitude of species present in the Caribbean. Of more than 300 species which are taken commercially, 50 to 100 are commonly found in the fish markets. The relative importance of the different species varies from country to country, but the more important groups, in all countries, include groupers, sea basses (Family *Serranidae*), croakers (F. *Sciaenidae*), snappers, yellowtail, muttonfish (F. *Lutianidae*), and jacks (F. *Carangidae*).

The clupeoid or herring-like fishes occur in numbers, too, and are known to occur in large quantities close to shore. The only important fishery for these species now takes place along the coast of Venezuela where they appear to be most abundant.

Various other pelagic species, including members of the Scombriformes (tunas and mackerels), are taken in small quantities. They make up less than 10 per cent of the total catch in Cuba and the Dominican Republic. In Venezuela, the proportion is somewhat higher. The types of gear used do not capture great numbers. Flying fish (F. *Exocoetidae*) contribute largely to the catches of the Windward Islands of the British West Indies.

Of the mollusks and crustaceans, spiny lobsters (*Panulirus* spp.) and shrimps are the more important. The former occur practically throughout the Caribbean from the Cayman Islands catch them in the greatest numbers, though they are with considerable quantities taken in Cuba. Turtles are also present; fishermen fished throughout the area.

There are many indications that the fisheries of the Caribbean can be expanded despite the fact that the waters may be less productive than those of the temperate regions of the world, and the suggestion that certain preferred species have become less abundant in some localized areas. Recent increases in the Venezuelan landings (see Table I), which come principally from the inshore waters, indicate that these waters will produce substantially greater yields. While fairly intensive fishing may be carried on in some regions inshore, larger catches appear possible by opening new grounds and by making a greater range of species available. Present operations tend to concentrate on the preferred species. In addition, greater advantage could be taken of the seasonal abundance of certain species such as jacks and kingfish. These and other species occur in large schools close to shore for limited periods of time.

As present operations in the Caribbean take place within the confined area of the continental shelf, the offshore waters appear to offer great prospects for future development. In addition to sardines and anchovies, bluefin tuna, yellowfin tuna, skipjack, albacore, little tunny, bonito, frigate mackerel, mackerels, wahoo, marlin, swordfish and sailfish are reported. One FAO observer (U.N.

Mission to Haiti, 1949) has reported schools of pelagic species in various parts of the Caribbean; another states that purse seines are not used in the Venezuelan sardine fishery because they take too many fish for the capacity of the present industrial plants. Brown (1942), writing of the fisheries of Trinidad and Tobago, is optimistic of the commercial possibilities of schools of bonito which occur off the coast of Tobago. He also states (1945) that fishermen of the Windward Islands take species of tuna incidental to flying fish catches and that greater use could be made of the tuna group. Similar reports come from other parts of the Caribbean. Unfortunately, relatively nothing is known as to the size, regularity of appearance, and behavior of these schools. Much has to be learned about the distribution and abundance of the pelagic species before their future potential can be predicted.

COMMERCIAL FISHERIES OPERATIONS

Development

The history of fishing in the Caribbean shows, with few exceptions, that the methods used by the majority of the fishermen have not changed appreciably during the last several decades. Variations in the dug-out canoes, which range up to 30 or 35 feet in length, and the "dori" or keeled double-end canoe are the most common craft. Canoes are slowly being replaced by sailboats of approximately the same length but of greater beam, and to a lesser extent by powered craft. Most of the gear employed includes pots, weirs or traps, various types of gill nets, beach seines, dip nets, cast nets, and hook and line combinations—principally the single hook and line.

Cuba and Venezuela have more powered and larger sized craft than the other countries. Of Cuba's total fleet of 12,000 vessels, approximately 2,500 are engaged in full-time fishing (Fiedler et al., 1947, and Martinez, 1948). About one-third of the 2,500 are powered and the remainder use sails. One-tenth of the full-time craft are more than 5 tons. Several motor vessels of modern design have been introduced in Cuba within the last few years. Cuba also has a fleet of 50 or more vessels with an average length of 100 feet. Until recently, the latter vessels fished principally off the Mexican coast.

Venezuela has a program in progress, which began in 1947, to improve her fishing fleet and other sections of the fishing industry. The work is being carried on by the Venezuelan Development Corporation, a government agency. One of the first projects was to issue credits for the motorizing of 750 of the fleet which included 4,300 craft in 1947. Motors being installed in 1947 ranged from 9.8 horsepower outboards for the smaller craft of 12 to 18 feet to 42 horsepower marine engines for vessels of 40 to 50 feet. The program has now expanded to include the construction of larger craft and cold storage plants. Its purpose is to aid where it can in the development of the fishing industry. A private non-profit organization, the Basic Economy Corporation, is also assisting in this field.

The Caribbean countries fall into two groups with respect to the importance of the fishing industry in their economy. Fishing in Venezuela and the island territories contributes appreciably to the food production. The organization of the industry is more advanced in Cuba and Venezuela than it is in the other countries of this group. The second group, which includes Colombia and the Central American states, have few fishermen and have shown until recently little activity in developing their aquatic resources. Costa Rica is presently investigating the possibility of establishing a fishing industry.

Although all the Caribbean countries do not collect fish production statistics the situation in this regard is better than most people realize. Many of the

countries supply estimates of production to FAO, while the Dominican Republic and Venezuela each report their catches by species. Cuba reports the Havana landings, which are the most important, by species.

Table I shows the most recent estimates of production available for each of the Caribbean countries, along with the average annual pre-war landings for some of them. Statistics for half the countries are based on information obtained by FAO and reported in the fisheries section of the preliminary draft of the Joint ECLA/FAO Working Party Report on Agricultural Requisites (1949). ECLA refers to the United Nations Economic Commission for Latin America. Where FAO statistics were not available, the writer used estimates given in various other publications. The reader is cautioned that production figures may include minor quantities from freshwater areas. Landings given for those countries which border the Pacific as well as the Caribbean include catches from both waters.

The island territories are the chief importers of salted cod and other products in the Caribbean. After the outbreak of World War II, imports became negligible. As these imports contributed largely to the total amount of fish consumed and because the island areas could have used more fish, it might have been expected that local production would increase. Although the over-all Caribbean production did become greater, increased landings were mainly limited to the two countries with the better organized industries: Venezuela and Cuba (see Table I). Fishing equipment used in the island areas was not capable of greater production and the number of fishermen did not increase. Venezuela and Cuba were able to increase their catches because they had organized industries, and a number of larger craft and more modern gear. Canning and salting absorbed the increased production. The most remarkable expansion has taken place in Venezuela. Ten years ago, most of the catch was eaten fresh. In 1947, about 17,500 metric tons, or less than 25 per cent of the total catch, reached the fresh market, the remainder being canned or salted.

The Central American countries have few fishermen in normal times. During the war, fishermen often found more remunerative employment in other industries. As the countries had adequate supplies of food from their agricultural resources, the fishing activities did not change.

Some of the Problems Involved in Future Development

Most of the countries are potentially capable of expanding their fishing industries. Recent developments in Venezuela and Cuba testify to this. However, it will be a slow process and many problems will have to be solved.

Generally, the people of Latin America are not by nature fishermen. The fishermen of the Cayman Islands are notable exceptions. The fact that the people are not traditionally seafaring retards fisheries development.

Trained personnel is required in all phases of fisheries, from fishermen to research workers. This basic requirement can be met by the organization of a small number of training centers, preferably within the area. As an immediate substitute, students can be sent to study in countries which have had more experience in fisheries matters. Such an arrangement should be temporary.

Marketing and distribution methods must be improved if greater catches are to be absorbed. Better transportation and storage facilities are required along with retail markets. Elaborate and expensive refrigeration plants are not suggested, but the wider use of crushed ice in the shipment of fresh fish could be of great advantage. Increased processing of fishery products would offer a

TABLE I
ESTIMATES OF PRODUCTION
OF THE FISHERIES OF THE COUNTRIES OF THE CARIBBEAN.
WEIGHTS IN METRIC TONS

	Average Prewar (1935-39)** Weight	Year	Weight	Source for specific year
Bahama Islands	.....	1939	800	Frank (1944)
Barbados	.....	1940	450	UN Interim Commission on Food & Agriculture (1945)
British Honduras	.....	1942	230	Fiedler et al. (1947)
Cayman Islands		No estimate		
Colombia	1,600	1947	1,600	ECLA/FAO**
Costa Rica*	1,500	1947	2,200	"
Cuba	18,000	1947	21,100	"
Dominican Republic	330	1947	470	"
French West Indies	.....	1940	400	UN Interim Commission on Food & Agriculture (1945)
Guatemala*	135	1947	135	ECLA/FAO**
Haiti	1,500	1947	1,500	"
Honduras*	135	1947	135	"
Jamaica	.....	1944	5,500	Thompson (1945)
Leeward & Windward Is.	.....	1945	6,900	Brown (1945)
Netherlands West Indies	.....	1940	450	UN Interim Commission on Food & Agriculture (1945)
Nicaragua*	100	1947	100	ECLA/FAO**
Panama*	700	1947	700	"
Puerto Rico	.....	1942	1,300	Fiedler et al. (1947)
Trinidad & Tobago	.....	1941	850	Brown (1942)
Venezuela	17,800	1947	64,500***	ECLA/FAO**
Virgin Islands (Br.)	.....	1945	200	Brown (1945)
Virgin Islands (U.S.)	.....	1930	280	Fiedler et al. (1947)

* Estimate includes Pacific coast landings.

** Data presented in the preliminary draft of the Joint ECLA/FAO Working Party Report on Agricultural Requisites (1949).

*** Excludes canned fish production, mainly sardines. Lacking an accurate conversion factor, it is estimated that 8,000 to 10,000 metric tons of raw material were used for canning. Fish were first canned in Venezuela in 1943.

further means of absorbing larger catches. Processed products which are inexpensive and adapted to the tastes of the people should be developed.

The indigenous people of the Caribbean countries generally do not care for fishery products. They prefer meat. This is particularly true in Central America. Consumer education programs sponsored by the governments are necessary to encourage these people to eat more fish. Advertising programs of this type have proved successful in other regions of the world in increasing the domestic consumption of fishery products.

Present fishing methods and equipment can be improved. According to the ECLA/FAO report cited, the 6,300 fishermen of Iceland catch considerably more fish than the 135,000 or more in Latin America. Granting that the north temperate waters are richer in resources, the wide use of non-mechanized gear in Latin America is largely responsible for this great difference. The introduction of better craft and gear involves an outlay of capital beyond the means of most ordinary fishermen. Governments may be able to offer financial assistance in the form of credits or loans. Evidence of the effectiveness of such schemes has been shown, for instance, by the Venezuelan Development Corporation which has been instrumental in increasing fish production in Venezuela. Experimental fishing investigations would be extremely profitable in the determination of the most suitable craft and gear. International cooperation in such work would be beneficial and would avoid duplication of effort and keep

costs at a minimum. Any introduction of improved craft and gear must be gradual in order that the increased catch can be absorbed.

The effective expansion of fishing operations to include the offshore pelagic species, such as the tunas, involves large investments for mechanized boats and gear. Such enterprises cannot be expected until there are assured markets for the catches. Nevertheless, this field offers great possibilities. Government assistance and outside help in the form of technical knowledge and capital appear necessary before offshore fishing operations become extensive.

MANAGEMENT OF THE RESOURCES

Problem

The greatest need in the Caribbean is development and exploration. Agencies responsible for fisheries matters should give these problems the highest priority. They must be attacked with energy and imagination. The Caribbean people have the necessary talents. Recent advances in Venezuela testify to this.

Although development is the first essential, management plans must keep abreast with the former if the present and future fisheries are to maintain sustained yields. From the biological point of view, ideal management controls exploitation to allow recruitment and growth to be equal to the catch. Replacement would be equal to the catch. No fishery in the world operates under such an ideal situation. However, there are management programs which have permitted once depleted fisheries to rebuild and successfully maintain increased yields. Further research will probably determine the optimum yield. Theoretically, most fishery biologists are working toward such a goal. However, the approach is not always the desired one. It is unfortunate that many research programs become academic rather than practical.

Some of the Caribbean countries have agencies for fisheries matters and some issue regulations governing fishing practices, such as prescribing types of gear to be used and fishing seasons. Many of the regulations are probably useless and perhaps even harmful. Regulations formulated without proper knowledge of a fishery's requirements usually serve no useful purpose.

None of the Caribbean countries concerns itself, to any effective degree, with biological research. The fact that three countries collect landing statistics is encouraging. It is hoped that others will follow their good example. Venezuela, Cuba and Puerto Rico conduct some technological research. The initiation of developmental programs, particularly in Venezuela, testifies to the fact that the countries of the Caribbean realize their importance.

Immediate Requirements

Proper management programs cannot be instituted without recommendations based upon investigations by trained personnel. The basis of management is a knowledge of the relationship between recruitment and growth and the catch, and a knowledge of the life history of the species involved. The former should be given the highest priority. With numerous closely related species of the same families, neither phase of the problem will be simple in the Caribbean.

Although it is usually impossible to measure in numbers the magnitude of various populations of commercial species, it is possible to determine whether the population is increasing or decreasing. This can be determined by a system of catch statistics together with a record of the fishing effort required to take the catch, the area fished, and adequate sampling of the landings to determine size and age compositions.

Although neither the management nor the development of fisheries is easy,

as more advanced fishing nations have discovered, there is nothing involved which is beyond the capacities of the Caribbean people. The fisheries of the Caribbean have made an important contribution towards obtaining a balanced local diet. They are capable of much more. The exploitation and proper management of the resources of the sea offer a challenge to man's ingenuity.

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WEDNESDAY—NOVEMBER 16

Chairman—J. L. BAUGHMAN, Chief Marine Biologist,
Texas Game, Fish and Oyster Commission, Rockport, Texas.

New Developments In The Menhaden Industry

JAMES NELSON GOWANLOCH

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MENHADEN occupy a unique role in the economy of the ocean and in the economy of man, with whom they certainly have no personal interest. Fairfield Osborn and William Vogt have so well expressed the idea of a "plundered planet" and the "Road to Survival." This must inevitably lead man to contemplate his use of the vast and strange fields of the oceans of the planet upon which he dwells.

Menhaden in those oceans perform a peculiar although not a unique part. They harvest the "grass of the sea," the diatoms, desmids and dinoflagellates, copepods and other teeming microscopic plant and animal organisms of the seven seas and by ichthyological alchemy transform them into lipstick, house paint, chicken food and drugs that must enter, to save human lives, the worlds of otherwise doomed human beings. Menhaden, therefore, merit regard.

The Menhaden fishery has risen spectacularly to excel by its more than one billion pounds annual production all other single fisheries in the western hemisphere. These figures have been very kindly provided to the writer by Dr. Lionel Walford of the Fish and Wildlife Service. What makes the impact of this fact more severe is that at no time in our recorded history have the materials derived from the Menhaden fishery been more critically needed.

The writer had the great privilege of participating in the recent United Nations Conference at Lake Success, New York, the first ever held designed to contemplate in a global pattern the utilization and conservation of this planet's natural resources in terms of world nations and world populations.

It is necessary in the evaluation of any fishery or other resource to orient oneself and see wherein in the pattern of human economy that fishery fits.

Two species of Menhaden exist on the Atlantic coast. Two species exist on the coasts of the Gulf of Mexico. Their pursuit and capture is accomplished by a highly specialized fishery method, i.e., the use of peculiar gear called the purse seine.

Menhaden are not used directly as human food, although during the war an attempt at canning these species for direct human food was made.

Utilization of Menhaden exceeds in length of time any other application of fisheries' products in continental America since the Indians instructed the Pilgrims to plant Menhaden and corn together.

The intervening years have held the record of changing and technologically more and more refined processing. Menhaden oil, the first product, was simply secured by permitting the fish to rot in barrels. Later, omitting the long inter-

vening history, it may merely be pointed out that the fish scrap became fish meal, used to fortify stock foods.

The writer served as a member of a wartime committee of the National Research Council which, upon the recommendation of the President of the United States, issued an order forbidding the use of any fish meals as fertilizer since its value elsewhere was so great.

The present situation is this. At no time in the history of the world has there been greater need of the proximate and ultimate products of the Menhaden industry than now exists.

The Gulf of Mexico, with 750,000 square miles, one of the great inland seas of the world, remains virtually unexplored. Its potential productivity may well be not alone of national, but of global importance. The investigation of the Gulf of Mexico should be given high priority in any national hydrographic and marine biological program and the search for knowledge of Menhaden resources should have in that high priority a high position on the scientific agenda.

It should be pointed out that the United States in 1948 produced 56,200 tons of fish oil, our republic being the largest producer of fish oil in the world. It should be further pointed out that in that year, 1948, Menhaden provided 49 per cent of our total fish oils.

A vast amount of careful scientific research has established the importance of the amino acids derived from Menhaden protein products, known as fish water or "fishstick" and no longer desiccated to the stage of fish meal. Within the past few months, there has appeared a flood of papers indicating that these amino acids (which are the building stones of proteins that make up the structure of all animals, including man, and of all plants) are not adequate when they are derived from plants, but when they are supplemented by the addition of only five per cent of fish amino acids (in these experiments specifically fish amino acids derived from Menhaden), the deficiencies are remedied and an astonishing impetus is given both to growth and, in the instance of poultry, to egg production.

One factor must be here emphasized. The essential conduct and the desirable expansion of the Menhaden industry come into violent and head-on collision with one factor, i.e., the misunderstanding of three things: first, the fact that the proper use of the Menhaden fishing gear, the purse seine, does not involve the capture of game fish or other commercial fish; second, the fact that, as established particularly by the excellent pioneering and convincing studies augmented by still unpublished and vast scientific surveys supervised by Jack Baughman, Menhaden do not constitute an element of any importance whatever in the food chain of game fish or of other commercial fish; and, third, that the proper use of the purse seine (which is the only practical use of this gear) does not in any way damage the nursery grounds of shrimp, of game fish or other commercial fish nor of oyster grounds.

The Menhaden fishery, the greatest in the western hemisphere, presents two problems. First is the problem of efficient production, second is the necessity to show that public good does not conflict with private enterprise in the Menhaden fishery. In no fisheries question in decades have the problems been more clearly defined.

Outline Of A Research Program On The Life History Of The Trout And Redfish

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THE GROUNDWORK for life history studies of the trout (*Cynoscion nebulosus*) and the redfish (*Sciaenops ocellata*) was laid by John C. Pearson in his paper "The Natural History and Conservation of the Redfish and Other Commercial Sciaenids on the Texas Coast" (Bull. U.S. Bur. Fish. 44:129-214).

While Pearson's work on these two fish solved many major problems of their life history, there still remains an enormous amount of biological and ecological work to be done before it is possible to determine a valid factual basis for management practices and legislation to conserve these fish.

Probably the question most urgently in need of solution now is the relationship of these fish to other marine inhabitants of the bays and Gulf, as well as to man, and what effect this relationship is having on the numbers of these two species. What is the food of these species and do the bays furnish sufficient food to support a large population?

This is particularly important in regard to the smaller stages, up to three or four inches in length, about whose food little is known.

Much work along these lines has been done by the laboratory of the Texas Game, Fish and Oyster Commission. From June 7, 1948 to August 31, 1949 the stomachs of 13,288 trout and 3,137 redfish were examined and, in general, it may be stated that the principal food of both species is shrimp. However, the fish examined have all been adults, and there is no accurate knowledge regarding the requirements of the immature fish.

Old Coast and Geodetic Survey charts show that, in many areas of the Gulf bays now having muddy bottoms, there was formerly sand or shell, both of which are apparently fairly well liked by these two species. Has this change damaged the carrying capacity of the bays so that they will no longer supply the population of marine organisms they once did?

What is a normal spawning? Is there a great enough deposition of eggs by these two to produce enough young fish to utilize all the food now produced in the bays?

To answer this it is necessary to know exactly where these spawning grounds are. Are they on clear sand bottom or are they located in areas where there is a dense bottom vegetation? What value is such vegetation, if any, to spawning fish? Should these grounds be protected? If so, why, and from what? How does vegetation affect the adult fish? In one case, in Currituck Sound, it was observed that when the vegetation was destroyed in a certain bay, *fishing declined* 90 per cent.

What is the actual effect of nets other than shrimp trawls on these species? Are these nets placing too heavy a drain on the species through selective action? Do trash fish move in to take the place of the much-sought-after redfish and trout when they are removed from an area? Is the action of the shrimp trawls in removing millions of pounds of trash fish from the waters each year beneficial or damaging? If these trash fish are not removed, will there be many more competitors for shrimp in the bays and in the Gulf? What effect will this have on the food of the two species in question?

Do trout and redfish migrate? If so, where do they come from and where do they go? What controls this movement? Is it temperature, currents, food

concentrations, spawning, water turbidity, or just an urge to travel to greener pastures? What predators eat them? What perils beset the growth of fry? What diseases, parasites, or illnesses kill the older fish?

How does the sports fishing affect them? Is it true that catches average much less in number than they used to, but is this because there are less fish or because there are more fishermen? The population of the Texas coast has increased tremendously during the past fifty years. How many more fishermen are there now than in 1900? What is the effect of the taking of thousands of undersized trout and redfish (all of them too small to spawn) by sportsmen?

According to the Pacific Halibut Commission, in each stock of fishes the major changes "are due to the fishery itself."

The Commission says that the same principles applied to any fishery. From this, there is certainly no reason to believe that the destruction of thousands and thousands of small trout and redfish that have never spawned will have any other than a major and adverse effect on the fishery of our own coast.

With this in mind, should a size limit be placed on the fish in the sportsmen's catch as it is on the commercial fishermen's? What size limit, however? Should it be a minimum length, or a maximum, or both? Should trout and redfish be placed on the game fish list so that they can not be sold in the markets even though a hungry world needs all the food it can get? If this is done, should a bag limit be placed on the sportsmen's catch so that the stock will not again be decimated and we may keep for the few what should be used for the benefit of the many?

Faced with these questions, it has been somewhat difficult to prepare an integrated program that will cover everything that needs to be covered, particularly with the biologists and equipment on hand. However, the problem is being attacked from as many angles as possible, in order to obtain as much data as possible with the means at hand.

A series of stations has been set up covering the coast from the upper end of the Laguna Madre below Corpus Christi to Pass Cavalla. The primary purpose of these is to establish the location of the spawning grounds for both trout and redfish and to determine the type of bottom, the amount of vegetation, and all other conditions affecting these, as well as the actual time of spawning, wherever feasible. An interesting thing in this regard is that, while it is yet entirely too early to draw any conclusions, there are a number of indications that very small trout, less than a week old, prefer a clean, white sand bottom, where there is a heavy growth of the marine plant *Ruppia maritima*. This is very noticeable and, while found elsewhere, they are most plentiful in this type of habitat.

Procedure has involved sampling by various methods at each one of the stations and the keeping of meteorological and hydrographical records. It is felt that, by this approach, and necessary variations upon it, it may eventually be possible to determine the type and frequency of the areas necessary as nursery grounds for the small fish and, by stomach analysis, what food they utilize that may be different from that of the adults.

It may be found that the presence or absence of certain types of plankton is necessary for the subsistence of small fish, and some physical, hydrographical, or meteorological factor may govern this. In this connection, it is necessary to know whether there is any correlation between the turbidity of the water and the available food for these immature forms. Has increasing turbidity of the bays cut down photosynthesis to the point where they no longer produce suffi-

cient food for the young, and is this a factor in the amount of trout and red-fish present? Moreover, does this turbidity act as a feeding inhibitor on the adults?

Gonad development is being studied on all fish collected and an attempt is being made to correlate the spawning ages, length, and weight as closely as these three factors can be correlated. This information is also being tabulated by area, season, salinity, temperature, and any other pertinent methods.

A fish trap has been installed in Cedar Bayou, a shallow natural pass between St. Joseph and Matagorda Islands. This trap is attended by one biologist and a crew of fishermen. The main objectives of this work are as follows:

1. Time of migration of various species through the pass.
2. Magnitude of these migrations.
3. Examination of the gonads in order to determine spawning time and the habits of fishes using the pass.
4. Size and age of fish and crustaceans using the pass.
5. Examination of the species involved to determine the food of the different size classes and to establish the difference, if any, between the food of fishes in the Gulf and the food of fishes in the bays.
6. Tagging.
7. A comparative study of the numbers of species utilizing the pass to endeavor to determine the value of such a pass in the replenishment of the population of our bays.
8. By seine hauls or other necessary means in the same area, to determine the population density and the species using different types of habitats such as mud or sand bottom or oyster reefs. (This is important as it probably has a great deal of bearing on the variations in productivity of the bays).
9. Hydrographical and meteorological studies will be made and every attention will be given to determining, if possible, the actual volume of water interchanged by means of this pass, and the extent that this water affects the bay area. In doing this it is proposed to utilize floating postcards for the accumulation of data, like those used by Dr. Langlois and his staff at Put-in-Bay, Ohio.
10. After sufficient data have been accumulated by the use of traps and seines, with no obstruction at the mouth of the pass, two subsidiary wire curtains are to be installed in the Gulf, perpendicular to the shore, on each side of the pass, to simulate jetties and to determine the effects of such jetties on the usage of such a pass by fish and other marine life. It is also hoped that by trapping these curtains at different distances from the shore, it will be possible to determine the movements and migrations of the various species in relation to the topography of the shore line.

It can readily be seen that the information gained in this manner at the pass will correlate and amplify the study of the bays.

A third phase of the program depends upon the operation of the fish cleaning table at the laboratory itself. This table, which was set up in 1948, has been very useful. For the privilege of retaining the stomachs and accumulating other necessary data, the staff will clean the catch of any sportsman or commercial fisherman who brings it in. Signs scattered over the area inform everyone of this fact and, during the past year, some fifteen or twenty thousand fish have passed across the table. Costs have been very small, and the worth of the data so accumulated has been great. Food, age, length, weight, and scale information are the chief products.

The impact of the shrimp fishery is being studied, also. In actual practice the

laboratory trawler has been equipped with four different shrimp nets. One of these is a regular 65' shrimp trawl as used on this coast in the commercial fishery. A second 65' net is identical in all respects with the first except that it has a Guthrie culling bag, developed on the east coast, instead of the regular sack. Two other nets are used. These are of a type developed locally within the last two years and are known as "Kite Nets." They are totally unlike the ordinary shrimp trawl inasmuch as they have no lead lines, no cork lines, and no bottom. These nets in operation have proved to be excellent over rough, soft, or grassy bottom, consistently producing catches where nets of the regular pattern cannot be used. They have another advantage, the difference in construction causing them to act as culling nets, greatly reducing the percentage of fish in the catch.

Of the two nets of this type which are being used, one is equipped with the ordinary sack, the other with the Guthrie culling bag mentioned above.

This part of the program will be carried on under actual fishing conditions, the laboratory boat operating at the same time, in the same area, under the same conditions, as the commercial shrimping fleet. Its purposes are as follows:

1. To determine the species of fish taken in the commercial shrimping operations and the ratio in numbers, size, and poundage of these species to the amount of marketable shrimp obtained.
2. To determine the actual ratio of the various sizes of shrimp during the various seasons to the marketable shrimp.
3. To determine the ratio of the poundage in unusable shrimp and fish to the poundage of shrimp produced for market.
4. To determine the amount of trout and redbfish, if any, taken in commercial operations.

In connection with this part of the investigation, meal and oil analyses of the various species will be made, and it is hoped also that it will be possible, a little later, to conduct some experiments as to the possibility of utilizing the scrap fish for canning.

The Florida Mullet Research Program

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IN A NATION ranking second in the world in the production of fish, Florida is among the leading states. Only California, Massachusetts and Virginia landed greater quantities of fish in 1945 (Anderson and Power, 1949). Of the food fish caught in Florida, the mullet is the leading species.

Two varieties of mullet are recognized by the industry. These are the striped mullet (*Mugil cephalus*) and the silver mullet (*M. curema*). Of these the former is caught in greater quantities. Two other species may possibly occur in the commercial catches but they are of negligible importance. These are *M. lisa* and *M. trichodon*.

No continuous record is available of the amount of mullet landed in Florida. Federal government statistics for the State are available for some years (Table 1) but statistical surveys have been made by the United States Bureau of Fish and its successor, the United States Fish and Wildlife Service, only at relatively long intervals, as funds were available. Florida State law has required statistical reports from the fishing industry since 1933, but even since then there is not

TABLE 1
LANDINGS OF MULLET IN FLORIDA FOR VARIOUS YEARS
REPORT OF U.S. FISH AND WILDLIFE SERVICE

YEAR	LANDINGS IN POUNDS	
	WEST COAST	WHOLE STATE
1890	15,555,964	
1897	15,574,455	
1902	26,309,800	
1908	16,144,600	
1918	26,380,059	
1923	28,454,464	34,652,664
1932		21,141,449
1934		23,966,300
1937		27,679,600
1938		28,593,900
1940		31,877,100
1945	26,715,600	34,527,900

a continuous record of mullet figures available. (Table 2). The State has never had adequate machinery to collect complete fishery statistics, and the figures obtained are recognized to be incomplete. It is therefore impossible to determine from the landings whether the mullet fishery is declining. Taken at face value the figures available would indicate that it is not. Opinions expressed by those connected with the industry are contradictory, although the general consensus is that the abundance of mullet is less than previously. Certainly in some areas fishing is poorer than it was, and there is evidence that the maintainance of the level of mullet landings has been due to increased fishing intensity and efficiency of the gear. A decrease in the average size of the mullet has also been reported from certain areas in Florida, notably along the north Gulf coast, west of St. Marks.

Due to a lack of research, the basic facts which are necessary for an evaluation of the economic and biological status of the mullet fishery are not available to guide its proper management. The program at present being undertaken by the Marine Laboratory of the University of Miami for the Florida State Board of Conservation is designed to provide these facts.

Among the first tasks is to attempt to secure better landing statistics, since a proper evaluation of the present condition of the fishery and its future trends

TABLE 2
LANDINGS OF MULLET IN FLORIDA, 1933 - 1948.
REPORTS OF FLORIDA STATE BOARD OF CONSERVATION.

YEAR	SILVER MULLET	STRIPED MULLET	TOTAL
1933		33,915,350	*33,915,350
1934		33,915,350	*33,915,350
1935		26,163,452	*26,163,452
1936		26,163,452	*26,163,452
1937			no record
1938		24,516,620	24,516,620
1939		32,921,522	32,921,522
1940		33,718,807	33,718,807
1941	167,772	39,399,504	39,567,276
1942	666,828	55,766,115	56,432,943
1943	733,818	55,952,367	56,686,185
1944	14,533	39,657,603	39,672,136
1945	28,238	34,562,063	34,590,301
1946		36,889,793	36,889,793
1947	24,873	28,530,058	28,554,931
1948	8,890	35,662,695	35,671,585

*Average of two years.

cannot be made without trustworthy figures. The industry must first of all be made aware of the need for such figures, since its cooperation is essential to the success of a statistical system. A start has been made in this educational program by the publication of a bulletin explaining the need and function of fishery statistics. (Idyll, 1949a). We must now proceed to gather as accurate data as is possible. The influence on increased fishing intensity and gear efficiency will be studied in conjunction with the total landings.

The possibility of the existence of more than one population of mullet in Florida is a second problem which we are concerned with. It may be that the mullet caught in the southern part of the State are distinct from those north of Tampa, for example, and these, in turn, distinct from the mullet of the north-west coast. On the contrary, it is quite possible that all the populations intermingle, moving from one area to another. The management practice will differ, depending on which of these two situations prevails. For example, if the north-western populations are distinct from the others, perhaps the prevalent smaller average size in this region is a racial character. If the populations mix, this small size may indicate an over-intensive fishery or one which is operating with nets with too small a mesh. The implications to regulation are obvious.

This problem is being attacked by the most direct method, namely, by tagging. For the present, morphometric racial analysis is not being carried out. The tags being used are the Petersen or button tags. We have released 772 tagged mullet up to the present time, at 10 different places on the Florida coast from Naples to Destin. The tags have already shown us that the summer populations of mullet do not move far, since the great majority of tags put on in July and August were recovered near the place where the fish were released. Returns from our October tagging are starting to come in and we will have a clearer picture of the mullet movements as we continue the experiment.

The intensity of fishing is another aspect of the mullet problem and again our tagging is giving us some information. A high intensity is indicated by our returns from some regions (Table 3). Over 40 per cent of the tagged fish have been recaptured from the Apalachicola tagging and high returns are shown for other areas.

No exact information is available as to the size and age at maturity of the mullet constituting the commercial catch. Returning to the smaller average size of mullet caught on the Florida coast from Pensacola to St. Marks, an important question arises as to whether these fish are younger than those larger individuals caught in the rest of the state. The age composition of the catch is

TABLE 3
RECOVERIES OF TAGGED MULLET

DATE TAGGED	PLACE TAGGED	NO. TAGGED	NO. RECOVERED	PERCENTAGE RECOVERED
7-16-49	Cedar Key	80	7	9.7
7-18-49	Steinhatchee	84	3	3.6
7-20-49	St. Marks	87	12	13.8
7-22-49	Apalachicola	100	42	42.0
7-23-49	Port St. Joe	41	3	7.3
7-24-49	Destin	64	23	35.9
8-22-49	Punta Gorda	100	27	27.0
8-28-49	Naples	41	0	0
8-29-49	Cortez	51	12	23.5
10-25-49	Steinhatchee	83	4	4.8
11-9-49	Homassassa	42	0	0
		773	133	17.2

likewise important in estimating the future abundance of the mullet. The age of many fish can be determined by the markings on the scales, which are caused by different growth rates at different times of the year. It has been widely stated that the scales of fish inhabiting tropical waters do not have these markings. We have collected large numbers of scales from Florida mullet, both from the commercial catches and from tagged fish. A study of these scales is under way to discover whether age can be determined from them. Marks are present and we have hope that we may be able to relate these to the age of the fish.

The size at maturity of the mullet is not well known and this basic information is being obtained. This phase of the investigation, as well as that dealing with the size of mullet caught in various net mesh sizes, is reported in another paper.

Different types of gear used in the mullet fishery are being studied. One report on this has been issued (Idyll, 1949b).

Finally, the gaps in our knowledge concerning the spawning and early life history of the mullet are being filled in as quickly as possible. The results of all these studies should provide the basis for an intelligent management of the mullet fishery, whose objective would be the stabilization of a high level of steady production.

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Gear Studies In The Florida Mullet Fishery

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DURING THE PAST YEAR the Marine Laboratory of the University of Miami has carried on a study of the Florida mullet fishery. This research was undertaken because of persistent reports that striped mullet, *Mugil cephalus*, were becoming increasingly scarce, and fear was felt that the industry would continue to decline unless some corrective measures were taken. Investigations of fishing methods and gear and studies of the life history of the mullet have accordingly been carried out.

Fishermen and fish dealers, in an effort to explain the causes of the decline, have condemned practically all methods of fishing for mullet on one ground or another. Studies of various methods used in the fishery have been made, with the charges against them in view.

The use of the gill net appears to be criticized less than any other. This net is selective in the size of fish it takes, since fish too small to be gilled pass through it, while fish too large to force their heads into the meshes usually are able to back away and avoid being caught. This type of net is probably the least efficient, especially when used simply as a gill net and not employed as a seine. The only criticism made against gill nets is that so many of them are in constant use that mullet have no chance to occupy an area without being disturbed. In some areas along the coast so many fishermen are active that all available fishing grounds appear to be occupied almost every day or night, and

doubtless each fisherman catches fewer mullet and has less choice as to where he will fish, as a direct result. No harmful effects of this type of net are evident, insofar as damage to feeding grounds or to small mullet is concerned.

The trammel net is a more efficient type of gear than the gill net, in that it will take fish which are too large to gill so that the range of sizes of fish captured is greater. Small fish are able to go through this net. In some localities this gear is used as intensively as the gill net, and draws the same criticism. In addition, many fishermen claim that this net is destructive because it takes such a range of sizes. However, the greater range is only in the direction of larger fish and this net is no more destructive to small fish than is the gill net.

Many fishermen would like to abolish night fishing. They point out that during the war, when night fishing was not permitted, there was great abundance of mullet. This they attribute to the fact that mullet were permitted to rest and feed unmolested during the hours of darkness. It is not known whether the increased abundance of mullet in 1942 and 1943 was due to the curtailment of night fishing or to a natural cycle in which the mullet population was at a peak. Possibly a combination of these factors was at work. Not only was night fishing curtailed, however, but there were considerably fewer fishermen exploiting the mullet resources at that time, since many fishermen were in the service. Restriction of fishing to the daylight hours, coupled with a decrease in the intensity of fishing operations, may have contributed to the large catches per unit effort by allowing time for the mullet to "bunch," thereby becoming easier to catch. In other words, the ban on night fishing may not affect the population of mullet, but it may have aided in making that population more available to the fishermen.

The use of the flambeau, made by wiring a large bundle of rags or burlap to the end of a pole, soaking it in gasoline, and igniting it, has been widely attacked. Burning gasoline drips from the flambeau and spreads over the water. Often more gasoline is poured on the water to increase the burning area. The resulting conflagration is startling and frightens the fish. The flambeau is disliked by all fishermen who do not use it. They claim that its use drives mullet out of the area, that it causes a coating of oily residue to settle on the bottom which destroys feeding grounds, and that it burns off the grasses among which mullet like to feed.

Observations show that the flambeau does cause mullet to scatter, resulting in many of them becoming tangled in the meshes of the net. It is doubtful, however, if it causes the fish to vacate the area for any length of time. The larger number of fish caught by this method than by the use of ordinary lights should not be grounds for outlawing the operation.

The charge that an oily residue covers the bottom is groundless. There is practically no residue left when gasoline burns, and what little soot or gasoline may remain is quickly dissipated by the tide. When used in grass the flambeau does scorch and doubtless kills much of the vegetation. In such an area it is possible that the feeding grounds are affected to some extent. It has not been determined just how burned grasses may affect mullet. At any rate, grasses are temporarily damaged, and until it can be proven what effect this has on mullet, this charge must be considered. A more serious charge can be brought against the flambeau. It is exceedingly dangerous to the fisherman who uses it, and to his boat. Furthermore, there constantly exists the danger that grasses and trees on shore may be set afire and result in considerable property damage.

Stop-nets are the targets for much criticism by fishermen all along the coast,

and even many men who use them claim that they should be abolished. The critics believe that "stopping" operations destroy feeding grounds because they involve so much disturbance of the bottom. They claim that mullet will leave an area that has been stopped and not return for days or weeks. It is charged that stop-nets destroy many fish which are not used. The chief complaint is that stopping operations spoil an area for fishing by the crews who come later, and that they encompass too large an area.

Stop-netting was especially studied because complaints against it are so persistent. Damage to the grounds was carefully noted and found to be exaggerated. The stirring of the bottom caused by walking on it or dragging a small seine over it is probably less than that done by choppy water and strong tides. Footprints and other marks are usually obliterated on the next set of tides. The slight churning of the bottom may actually be beneficial, serving to bring more nutriment within reach of the mullet and the microscopic plants upon which they feed.

The scarcity of mullet in an area that has just been "stopped" is probably due to the fact that most of the resident fish have been removed, and it takes some time to repopulate the area. The fact that a stopping operation has recently taken place can hardly be said to bar the entrance into the area of other mullet after the tide has obliterated all signs of the operation, which is usually within twenty-four hours. Mullet are very wary, however, and apparently avoid crossing net marks and tracks of seines as long as they are detectable.

A stop-net effectively blocks the escape of all the fish within its compass that are too large to go through its meshes. This usually includes a great variety of fishes, many of which are of little or no commercial importance. Most of the captured fish make their way into a deep area that is usually purposely included within the "stop" to provide a gathering place. Some fish remain in shallow water along the landward side of the net. Others are stranded in small pools left by the receding tide. Usually very few are left high and dry. Some of the stranded fish are destroyed by birds that are invariably attracted to a stopping operation. Some others fall prey to raccoons and crabs. The numbers so destroyed are small. The greatest destruction is by the fishermen, and it is willful. They have good reason to dislike catfish, rays and porcupine fish, all of which can inflict painful wounds, and their objection to sharks, crabs, and other creatures which tear holes in nets is understandable. But their dislike of many fishes stems simply from the fact that they must be removed from the net, and hence are a nuisance. For these reasons many fishermen kill all fishes which are taken in the nets, regardless of species. This habit justifies the charge of destructiveness levelled against them. It could be remedied by individual effort.

Stop-nets do cover large areas, it being quite common for several miles of shoreline to be included in one operation. The gear also takes a greater percentage of the fish from the place where it is used than does any other type of equipment, resulting in few fish being left for the fishermen who follow. Unless other conservation methods fail, and it becomes advisable to reduce the pressure on the mullet stocks by limiting the production of the fishery, the abolition of stop-nets cannot be recommended on grounds that they are harmful to mullet.

Drag-seining is frowned upon by many because, it is charged, seines damage the bottom and kill too many fish unnecessarily. Several types of drag-seining operations have been observed, ranging from the use of small gill nets and gill and stop-net combinations to heavy seines of almost a thousand yards in length operated by twelve-man crews.

The seining operations were checked particularly for signs of bottom damage.

Some of the smaller seines were used over grass and mud bottoms. It was noted that a small amount of grass and mud was brought up in each case, and most of the grass that was brought up was dead. It was evident that the lead lines passed over, rather than through, the grass and mud. These small seines were pulled by the cork lines, so that the lead lines were slack and did not dig into the bottom. The large seines were used over sandy or grassy bottom in each case observed. There was some digging in of the lead lines, especially near the working ends, since both cork and lead lines were pulled, and a man "footed" the lead lines at each end, thereby keeping them down. Even so, there was very little grass in the nets, and sandy bottoms contained very little evidence of the seine's passing. Those seines which were dragged ashore did bring with them a number of so-called trash fish, and these were left to die on the beach in many cases. While probably of little commercial consequence, the accumulation of dead fish upon a beach following a seining operation creates the impression of wastefulness and gives rise to justifiable criticism, especially from sportsmen, who may not consider such fish as useless. Much of this destruction could be eliminated by the simple expedient of returning unwanted fish to the water. The areas where seines can be employed are limited. Oyster bars, mangrove roots, rocky and uneven bottoms all curtail or prevent seining. For this reason, though seines may be efficient where they can be used, they cannot affect a large percentage of the feeding grounds of mullet.

The core of the problem lies not so much in the type of gear used or the methods of its employment, but rather in the size of the mesh of all types of nets, which governs the size of mullet taken. In order to ascertain what sizes of fish were taken by various mesh sizes, a number of samples of mullet, caught in nets of different mesh sizes, were measured throughout the past year. Also, in order to determine the size of mullet at maturity, records of the lengths of both male and female mullet which yielded roe or milt upon being stripped have been and are being gathered. This latter work was begun late in the spawning season last spring, and has just recently been resumed as the new spawning season is beginning. A larger sample needed before definite conclusions can be reached upon the minimum sizes at which both male and female mullet are mature. However, measurements taken so far indicate approximately what these minimum sizes are. All lengths referred to are from the tip of the snout to the fork of the tail.

From fourteen samples, three hundred and six sexually ripe mullet were obtained, of which two hundred and seven were males, or "white roes," and ninety-nine were females, or "red roes." The mature males ranged in length from ten and one-quarter inches to sixteen inches. The females ranged from eleven and three-quarters inches to nineteen and three-quarters inches. Approximately 87 per cent of the mature females were thirteen or more inches in length, while less than 30 per cent of the males were as long as thirteen inches.

These results indicate that the males seldom reach maturity until they are at least ten inches in length, while the females cannot be expected to mature at a size much under twelve inches. It also appears that the mature females are generally larger than the mature males.

Measurements of mullet caught in nets of various mesh sizes were made during all seasons of the year, but most samples were taken during the winter and spring months of 1948 and 1949. A mullet full of roe or milt, or heavy with pre-spawning fat, will become enmeshed in a net which a spent or thin mullet of the same length will pass through, so that at some seasons of the year the average size of fish taken by any net will be greater than at other seasons.

During the spawning season, especially after the first month of spawning, there are many spent mullet, or "spikes," in company with mullet still heavy with roe, and the pre-spawning season mullet vary considerably in their condition, so that it is difficult to determine when any one mesh size will take a larger or smaller class of fish. The change is gradual, and for this reason there has been no attempt to subdivide the samples into seasons. Any such division would be arbitrary at best.

The entire catch of 103 fish was measured from an illegal 2 5/8 inch stretched mesh. It was found that only 44, or less than 43 per cent, of the fish were under twelve inches in length. Of nine samples, each consisting of the entire catch of a 2 6/8 inch stretched mesh net and totaling 1460 mullet, 912, or over 62 per cent, were under twelve inches in length. Two samples of fish captured by 2 7/8 inch stretched mesh nets, a type seldom used, contained 174 fish, of which 92, or almost 53 per cent, were under twelve inches. Fifteen samples taken from 3 inch stretched mesh, and totaling 1728 fish, contained 862, or approximately 50 per cent, mullet under twelve inches. Of seven samples measured from landings of 3 1/4 inch stretched mesh nets, and numbering 795 fish, 237, or less than 30 per cent, were under twelve inches. One sample was obtained from a net rarely used at Cedar Key (where all samples were taken) of 3 7/8 inch stretched mesh. This sample consisted of 86 fish, all of which were twelve or more inches in length.

The legal minimum size limit on mullet for the state of Florida is now 10 1/2 inches. This permits the taking of fish, especially females, which are too small ever to have spawned. In some counties the minimum limit is further reduced. Levy County permits the taking of ten-inch mullet, and in the area west of the Aucilla River the limit is eight inches.

Fifty-one market samples (samples measured without regard to type of gear used in their capture, and selected at random) included a total of 7,049 mullet; 3,496, or almost 50 per cent, of these were under twelve inches in length.

It would appear, therefore, that the fishery is at present taking many mullet before they are allowed to mature. Further study is necessary before recommendations can be made as to regulations of size limits of fish or mesh sizes.

The Florida Sponge Industry

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ALL OF THE NATURAL SPONGES produced in the United States come from the coastal waters of Florida.

In past years sponges occurred in commercial quantities all along the coast of Florida from Biscayne Bay south to Key West and along most of the west coast north almost to Carabelle.

An average of over one million dollars worth of sponges has been marketed annually for the past fourteen years. In 1943, 1944, 1945 and 1946 the sales of wool sponges alone were well over two million dollars per year.

Production declined sharply after the sponge disease of 1939-1940, and by 1947 the landings were markedly smaller. The University of Miami Marine Laboratory, at the request of the Florida State Board of Conservation, undertook in December 1947 a brief survey of the sponge grounds north of Anclote

Light in order to determine the condition of the sponge beds. Particular attention was given to the deeper bars in from 16 to 22 fathoms. The results of that investigation presented such a somber picture that the Marine Laboratory was requested to survey to area north of the Dry Tortugas and west of Carabelle in an attempt to find new sponge beds suitable for commercial exploitation, and to seek new sponges which might be of possible commercial value but which are not now being utilized.

This survey was carried out in September and October of 1948. The first part of the cruise covered the coastal area from Tarpon Springs south to Florida Bay, past Key West, the Marquesas and Tortugas and north to Tarpon Springs again. The second part of the cruise likewise began at Tarpon Springs and continued north along the Florida coast to a spot offshore from Panama City.

The vessel used was the *P. Kremasto*, a Greek-type diving boat 42 feet in length, equipped with a Bendix DR-3 supersonic depth recorder. A laboratory bench was constructed in her waist.

Using charts of the region, stations were selected which showed as rocky ledges or as coral reefs.

When the station was reached, the bottom was carefully charted with the depth recorder, a buoy was placed at the center of the station location and the bottom was tested with a soaped sounding lead.

The vessel then circled the buoy while surface and bottom samples of seawater were taken, and surface and bottom plankton tows were made. The determinations for pH, temperature, salinity and dissolved oxygen were then carried out while the diver was being dressed.

The diver descended to the bottom and made a general exploratory dive, taking a sample of the bottom deposits and collecting specimens of all the bottom dwelling plants and animals. The biological specimens, when brought on deck, were carefully sorted and examined for any signs of disease. They were then tagged and preserved in alcohol for later, more detailed study in the laboratory. If no commercial sponges were found on the first dive, the vessel moved to a new location on the same bar and the diver again went down. Each station was therefore covered by several dives at different locations grouped around the marker buoy.

When commercial sponges were encountered, the diver worked the beds under normal sponge diving conditions for a given unit of time in order to determine the catch per unit effort at each sponge bar.

Twenty-two stations were worked during forty-three days at sea. Sponges were found in commercial quantities only at two reefs which were already known to the industry. Single specimens of bastard wire sponge were found at two stations, and a damaged yellow sponge was taken at another station. This was the only commercial sponge taken that showed signs of recent damage, but many of the sheepswool sponges taken from the shallow water producing bar had scars and evidences of old damage. The only other sponge ground that showed damage was a non-commercial cup sponge, which is closely related to the commercial sponges.

A joint survey was made in September of this year by the Marine Laboratory and the U.S. Fish and Wildlife Service in order to investigate recent reports of sponge mortality in the region between Anclote Key and Saint Marks. According to reports of the boat captains the mortality was first noted in December 1948 in 9 to 10 fathoms off Pepperfish Keys. Damaged sponges were observed in the Rock Island region in shallow water about the first of

June, 1949. Both hook boats and diving boats reported that within 20 days virtually all of the sponges inside of 7 fathoms were dead or damaged. The divers stated that all of the sponges in the 4 to 10 fathom range between Cedar Keys and Anclote Light had been destroyed, and that between Cedar Keys and Saint Marks 95 per cent of the sponges in this depth range had been destroyed. Southwest of Anclote Key in 5 to 5½ fathoms some damaged and some live sponges were reported in May; in July one boat worked this area and found no sponges, either alive or dead. According to the reports of the sponge fishermen, this is the southernmost limit of the sponge damage.

The sponge fishermen agreed that the present mortality affects the sponges in the same manner as the 1939-1940 disease. Wool sponges are more resistant than are the grass and yellow sponges; non-commercial sponges and some species of coral are also evidently damaged by the blight.

The survey on the Fish and Wildlife vessel *Pompano* indicated that a few healthy sponges remain, but that numbers of damaged sponges (and coral also) are present on the reefs. Several typical sponge bars were found to be entirely devoid of commercial sponges.

There is no way to estimate the exact loss that has occurred since the blight was first reported late in 1948. Results of this survey, when considered with the results of the 1948 survey, indicate that the sponge population is at present very low in the area investigated, and that most of the remaining sponges occur in less than 4 fathoms.

Definite evidence exists that the recent sponge damage is the result of a blight of some sort; whether or not it is the same as the disease of 1939-1940 will no doubt be determined by study of the diseased tissue by Dr. Galtsoff.

The entire Tarpon Springs sponge fleet is at this time at rest in its harbor, and none of the captains plans to put out to sea in search of sponges. In the past few months the vessels that have ventured out have not found enough sponges to pay for the expenses of the trip.

So far in 1949 (8 months) \$392,000 worth of wool sponges have been sold on the Tarpon Springs sponge exchange. This figure, when charted with the sales of previous years, continues the severe downward trend and is an indication of the critical condition of the industry.

As a part of the 1948 survey many types of non-commercial sponges were cleaned and tested in order to determine whether or not any were suited for commercial uses. None was found to be satisfactory. Lack of water retention, harshness or weakness of the fibers prevented the acceptance of any of the test group.

Quantities of several types of non-commercial sponges were dried and were submitted to biochemists in an attempt to utilize such sponges as raw material in the preparation of manufactured goods.

It is apparent that a normal recovery of the Florida sponge beds is unlikely to occur for a considerable time. The surveys conducted during the past few years clearly indicate that there is no likelihood that the industry can be saved by extending fishing in the waters of neighboring states, or by seeking sponges in deeper water.

It is suggested that the only practical means of hastening the re-establishment of the Florida sponge industry is by sponge cultivation. The type of bottom required for sponge cultivation must be carefully selected in order to provide a fairly smooth firm bottom, free from silting. Currents must not be excessive, but the water must be unpolluted and should have a normal salt concentration. There must be no danger of fresh water from rivers or streams en-

tering the sponge plantation. The water must be deep enough to prevent disturbance of the bottom by wave action, yet shallow enough to allow planting and harvesting of the sponges to be carried out without difficulty. Fortunately, rather extensive regions suitable for sponge cultivation exist in the Florida Keys and at a few places on the Florida Gulf Coast.

The technique of sponge cultivation consists of cutting the mature sponge into pieces which are attached to cement discs, or to wires, stakes, etc., which will support the cutting above the sea bottom. Care must be taken that the sponge is not crushed when it is being cut, and both the parent sponges and the cuttings must be protected from rainfall and other fresh water.

In the past century several experimental sponge plantations have been set up. Early work in the Adriatic was halted because of the hostility of the spongers and also because of excessive operational costs. Plantings made by a Mr. Monroe in 1880 were instrumental in the presentation of a sponge cultivation law to the Florida State Legislature. The law was not passed, and theft, with other difficulties, ended the experiment.

H. F. Moore of the U.S. Bureau of Fisheries in 1901 set up and maintained extensive experiments in Biscayne Bay and at Sugar Loaf Key. Cuttings were placed on cement discs and on stakes supported by cement triangles. The cuttings on the discs reached market size in about four to five years.

This cultivation experiments and the plantation set up for the Bahamas government by F. G. W. Smith prove that it is entirely practical to culture sponges if care is taken in the selection of the site and if proper methods are used. There is now in operation at Pott Cay, Andros Island, a privately owned sponge cultivation that is producing excellent sponges.

Plantations should be set up for the sheepswool sponge only. They are the most valuable, and are also evidently more resistant to the sponge blight than are the other commercial sponges. The very fact that it is cultivated makes the sponge more valuable, because the surface of the sponge that is in contact with the cement disc becomes very finely felted. This obviates the necessity of trimming any irregularities from the "root" and also permits the sale of cuts of this felted sponge for surgical and other demanding uses.

Although sponges cannot be grafted to produce a more desirable strain, they can be selected for good qualities, and cuttings should be made only from those sponges which possess all of the qualities of softness, water retention and resiliency which are prized in a sheepswool sponge. It is probable that a biologist would be able to develop a fast growing and resistant strain of wool sponge which would be of superior market value.

The establishment of a sponge farm is advocated both for the purpose of providing stock for the depleted beds and for encouraging and aiding private enterprise. It must be pointed out, however, that sponge cultivation is not a get-rich-quick or sure-fire venture. It offers limited returns for an investor and requires hard work to establish; in addition, it is subject to greater risk than ordinary agriculture. The early failures were due to lack of experience and knowledge. Any future plantations should be successful if they are properly located and operated, but the possibility of failure must be considered.

Some Considerations Concerning The Future Of The Sponge Industry

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NO ONE FAMILIAR with the facts will deny that the supply of genuine sponges has dwindled to an alarming degree and that synthetic sponges have made heavy inroads in the market places. The time has come when the facts should be faced squarely. Adoption of this policy and adequate planning to rebuild the industry may yet save it from exhaustion.

For every pound of sponges derived from the domestic fishery in 1948, over 13 pounds were produced in 1935, and for every pound of sponges imported in 1948, in 1935 nearly two pounds were imported. In 1948 United States imports were seven times domestic production. This rapid decline in supply has developed certain marked results: (1) Prices of domestic sponges in some cases increased over 800 per cent, thus pricing them out of many market channels; (2) This created a fertile field for the development of the synthetic sponge industry, with the result that there has been a rapid expansion of facilities for manufacturing of cellulose sponges in the United States and the almost complete replacement of genuine sponges with the synthetic products in the European markets. French interests holding the Farben patents are reported to have pushed the sale of synthetic sponges in France, the United Kingdom, Italy and other countries, while Sweden is also manufacturing synthetic sponges of excellent quality. (3) Only in those fields in which the genuine sponge has exceptional advantages over the synthetic has the market for the genuine sponge remained open.

From the foregoing it appears evident that (1) With improvements in quality and the lowering of prices of the synthetic sponge, the channels of trade open to the genuine sponge will grow narrower and narrower until the level of demand will fall to one of insignificance; (2) Proposed tariff increases, if successful, would further reduce the supply and raise the price level of genuine sponges. Such a procedure would benefit the manufacturers of cellulose sponges, encourage improvements in their product and automatically reduce the demand for genuine sponges to the vanishing point. (3) To change this trend it is necessary to develop a program of fishery management of the sponge areas to encourage their rehabilitation, rigidly enforce regulations protecting the undersized illegal sponges and develop methods of propagating sponges on a commercial basis to augment the fishery harvest.

As confirmation of the extent to which cellulose sponges have displaced genuine sponges, Dr. Richard Kahn, of the U. S. Fish and Wildlife Service, has figures to show that during the fiscal year ending June 30, 1948, the Bureau of Federal Supply, Post Office Department, Army Ordnance Department, and Navy stores purchased 44,446 natural sponges for \$36,000 as compared with 329,000 cellulose sponges for \$74,703. As a matter of fact, the Post Office Department's purchases consisted only of cellulose sponges, and no natural sponges whatever. It might be added that the government paid an average of 81 cents for genuine sponge while paying 22.7 cents a piece for cellulose, or about 1/3 the cost of the genuine sponges. These figures indicate the futility of trying to raise tariffs on genuine sponges and thus make it easier to supplant the genuine with cellulose sponges. Such a policy would hasten the demise of the industry. Instead, trade should be given every encouragement to

purchase sponges from all world production areas to maintain the demand wherever it still exists. With the received reduction of duty on imports of synthetic sponges from 60 per cent to 45 per cent ad valorem and a further reduction in price through devaluation on currencies, it does not appear to urge increasing the import duty on genuine sponges. One foreign manufacturer of synthetics is said to be prepared to ship several million of these to this country and is only operating at about one third of his capacity.

It is now generally recognized that the supply of our natural resources—soil fertility, forests, fisheries and game—is not inexhaustible. In fact many of these resources, like the sponge fishery, are in grave danger of exhaustion. It is now an established fact that these resources can be restored to productive levels by the establishment of a suitable program of management. In the case of the fur seals of the Pribilof Islands, pelagic sealing had reduced the stock to about 130,000 animals by 1910. By the adoption of an adequate program of management, that herd has been rebuilt to over 3 million animals, permitting the largest annual kill in history. Not so many years ago the future of the halibut fishery of our Pacific shores was a cause of grave concern. The adoption of a continuing program of fishery management has restored that fishery to former productive levels. Similar programs are being adapted to various other fisheries. The Gulf States Marine Fisheries Commission should undertake the development of procedures necessary to establish a similar management program for the sponge fisheries. Certainly an industry of such widespread national interest, an industry which has netted the sponge fishermen of Florida as high as 3 million dollars a year, yielding a product of such unique value to a number of our important industries, is worth saving. Immediate steps should be taken to develop such a program. This Institute should give consideration to the establishment of an International Sponge Commission for dealing with the development of a fisheries management program for the sponge fisheries of the Bahamas, Cuba, and the United States. Such a commission should be able to develop a program for stabilizing and placing the industry on a sustained yield basis.

In line with the foregoing suggestion, it should be remembered that Great Britain interested herself in the development of a plan of cultivation which was well on the road to commercial success when the blight of 1939 hit the Bahamas. Such a Commission could concern itself with attempts to safeguard the industry against repeated attacks of this kind. Dr. F. G. Walton Smith was one of the foremost leaders in the Bahamian development and should therefore be in a good position to evaluate the potentialities of such a program, if he can make a careful study of this proposal.

Sponges can be cultivated. The next step is to demonstrate that the venture is sufficiently practical to enlist private capital.

The greatest deterrent to a more important branch of trade is the relatively small size of the sponge industry with resulting high prices. Obviously if we could increase production and lower prices we would improve the competitive situation in relation to synthetic sponges.

It is a well established fact that the Japanese were cultivating sponges in the Marshall Islands before War II. Dr. W. M. de Laubenfels, who made an extensive study of the sponge situation in American Trust Territory this past summer, reports:

I am confident that if a good return is forthcoming to the natives, that a very considerable source of supply can be developed over the next five years from the Trust Territory. It is comparatively easy to

culture sponges there in large quantities, perhaps as many as twenty thousand to an acre. The waters in the lagoons of the atolls are policed effectively by the natives who live around the atoll, so there is not the trouble of stealing which in some parts of the world interferes with artificial cultivation. The natives have the requisite skill, and partly from Japanese teaching and partly from what I have shown them, are ready to go ahead. (From letter of October 3, 1949.)

Unfortunately, based on specimens submitted to the Sponge Institute, the cultivated sponges of the Marshall Islands do not appear to possess high commercial value. The question which comes to mind is: Would high quality commercial sponges, such as sheepswool, transplanted to these waters, reproduce high grade commercial sponges? Studies are in progress to determine the practicability of transplanting sheepswool or other desirable species from the West Indies to the Marshalls for determining whether they would grow and produce quality sponges. Fortunately Dr. de Laubenfels, in a letter dated October 31, advises that he was able to move live sponges as much as 200 miles to be used for cuttings, "and these are growing rapidly and healthily. There is good evidence that now I know how to move them." It therefore appears desirable to attempt such a venture. Dr. de Laubenfels' work was conducted under the auspices of the Pacific Science Board, comprising the National Research Council and the U. S. Navy, which provided excellent facilities.

In summary: The annual production of genuine sponges has sunk to such a low level that they are rapidly being replaced by synthetic products which are much cheaper in price, that under such circumstances the arguments favoring increased tariffs on imports of genuine sponges are specious and would merely lead to the more rapid displacement with cellulose and other synthetic sponges. If consumers, especially those who find no acceptable substitute for the natural sponge, are to retain their interest in the genuine article, they must get the supplies they need. Every possible effort must be made to provide a sponge fishery management program, to stabilize production and assure a sustained yield. This should be supplemented by encouraging the cultivation of sponges on a commercial basis. If a constant source of supply is to be assured it may be found desirable to transplant high grade sponges to other areas.

Some Possibilities for Fisheries Development in the Gulf of Mexico

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THE DIVISION OF OCEANOGRAPHY of the Southwest Research Institute was established only a few months ago after long consideration and study as to whether or not an independent not-for-profit institution of this character, dedicated to the economic advancement of the states of the Southwest, and the nation in general, could contribute to the development of the Gulf of Mexico as a great asset to the nation. Recommendations came from every direction that this field should be entered because there is so much to be learned, and because the other activities of the institution relating to production of food, of petroleum, and the processing of natural resources are so closely related to

this effort. The Division of Oceanography is confident that through scientific research and development it will be able, along with other institutions, to improve the usefulness of the Gulf of Mexico for the benefit of the public and at the same time enhance the opportunities for close collaboration among the various industries and sciences that want to take advantage of this great asset.

The great nutritive values of Gulf waters are widely recognized, partly brought about by the draining into them of major rivers. The problem of diminishing soil nutrients on agricultural lands is certainly not a problem that exists in Gulf waters. The Gulf offers an ever increasing opportunity as a major source for human and animal food.

In addition, the Gulf is the "meeting place of all sciences" and through an understanding of its actions it is possible to learn about the formation of sediments, such an important factor in the geological sciences, its abilities and limitations to absorb land wastes, its action on shore and offshore structures, and its effect on climatic conditions, both here and in other parts of the world. The Gulf is unusual in that it is one of the few bodies of water in the world that has a continental shelf of the character that gives us a great expanse of relatively shallow, saline, and warm water the year around. Any water area on or adjacent to the United States that can produce at least two times as much plant life as the best agricultural lands is certainly something to look into. The large numbers of papers on the subject of products from the sea presented before the recent United Nations Scientific Conference on the Conservative Utilization of Resources definitely shows exciting possibilities.

It is possible that the people of the Gulf Coast states do not sufficiently realize the potentialities of this asset, and believing that the petroleum industry is the only group that has a stake in the matter, may have been somewhat indifferent in fighting for the sovereign rights of their states and their own heritage in allowing Federal control to develop to its present controversial

The fishing industry is under discussion here, and it may be because some Texans are better cattlemen than they are fishermen that some rather unorthodox fish industry methods have been suggested there. Sufficient investigation has already been made to justify the feeling that fish can not only be "ranchd" but can also be "herded." It is recognized, of course, that normal types of ranch fencing are impossible in Gulf waters for the reason that any activities in the Gulf must give right-of-way to ships. At the same time it is recognized that if fish can be fenced in much as cattle are, not only can their movements be controlled, but control can be exercised over the raising of various varieties and various sizes. In one area one-year olds could be penned and in the adjoining area two-years olds. In other areas, similarly other species of varying ages and so on.

The "fencing" problems leads to the realization that devices must be restricted to those that can be used on the floor of the Gulf and of a character that will not obstruct the movement of ships. These devices could be in reality "corner posts" located at a quarter or half mile intervals, providing blocked off areas for the control of the movement, and retention of fish provided that some invisible and non-metal "fence" can connect these devices and thereby create what might be called "fish pastures." This, of course, limits possibilities to directed electronic or other rays of a type which, if arranged to create fencing comprising a very narrow band of an environment highly objectionable to the fish, would keep them in control. Work already done and in some cases applied, with various devices for highly localized control of fish, shows that when they get into certain electrically charged zones, they

appear to have no faculty for knowing the source of their discomfort and are as likely to go in one direction as another. Investigations have already shown that there is almost as much likelihood of their going through the experimental zones as there is of their backing out. Therefore, it becomes essential that an exhaustive study be made on the response of fish to various types of environment and inexpensive ways found to restrain them within the "water pastures."

In this connection, Southwest Research Institute has developed a cooperative arrangement with the American Institute of Radiation at Belmont, California, an organization which has been conducting exhaustive studies on fish reaction to various environments. In the past months, this program has progressed to the point where there is increasing promise of being able to herd and ranch fish in the future, and the Division of Oceanography plans to extend this basic work into large water areas.

The American Institute of Radiation is fast becoming a national center in the use of rays and radiation of all kinds, and some other exceedingly interesting work is being conducted there. One point of particular interest to the fishing industry is a new sterilization method which has much promise of being of great value in fish packaging and marketing.

"Fenced-in" fish must have food in addition to that available in the normal water environment, at least during certain times of the year and particularly at certain periods in their growth cycle, and the American Institute of Radiation has also been studying this phase of the problem. Their present work is limited to fresh water operations but the Southwest Research Institute oceanography division expects, in the reasonably near future, to extend this work in the saline Gulf waters. It is interesting to note that there is a great similarity between the types of food that are attractive to hogs and those attractive to fish. Certain feeds accelerate their rate of growth just as fertilizers speed the growth and size of agricultural harvests. Reports will be given to the industry from time to time as to the progress of this program. Drastic as some of these ideas may seem, it is by the process of reorientated approaches that major problems are often solved.

Some of the other projects in the field of oceanography are not as unorthodox as the fish program. A developmental project is under way for the utilization of algenates in combination with hydrocarbons that result in "solid gasoline" pellets comprising approximately 96 per cent gasoline and four per cent algenate—a new form of non-explosive fuel. Algenates not only have extensive applications in our food industry, but are finding uses in other industries, where they have advantages due to the peculiar characteristics of the material.

The effect of industrial wastes on fish and marine life is a major project that has been in progress for over a year and is sponsored by the Celanese Corporation of America. Already a great wealth of information has been developed on the effects of various types of chemical waste products on a variety of fish types, and in due course this material will be published. Other phases of the problem of industrial wastes and their effects on marine life, both in fresh and salt waters, are being studied.

Work being done for the petroleum industry is concerned with the effect of geophysical exploration methods on fish life, and a method is in process which has the promise of minimum harm to fish life, although it must be further proved that it has value as a geophysical exploration tool over water areas.

The Division of Oceanography and Meteorology is in the process of distributing its first publication, entitled "Bibliography on Offshore Petroleum Developments," by Emory N. Kemler, which is available for distribution.

THURSDAY—NOVEMBER 17

Chairman—J. MAYNARD KEECH, Professor of Management,
University of Miami, Coral Gables, Florida.

The Caribbean Crawfish Industry And Its South African Competitor

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1. The Crawfish Production in the Caribbean Area

PRODUCTION FIGURES are sporadic and derived from sources which are highly incomparable and in any event have to be brought to a common denominator so as to permit a sound judgment. In some cases only export data are available, as published in the *Yearbook of Fishery Statistics, 1947* by the Fisheries Division of the Food and Agricultural Organization of the United Nations. The production of spiny lobsters in the United States is mentioned in the recent publication of Chace and Dumont as 463,000 pounds landed weight on the Atlantic coast and 513,000 pounds landed weight on the Pacific coast. Both production figures refer to the year 1944. For 1945 we have a production figure 6,700,000 pounds for Cuba. For 1947 the following production figures are given:

Mexico	3,000,000 lbs. (estimated)
Bahama Islands	1,400,000 lbs.
Br. Honduras	700,000 lbs. (nearly all were exports)
Guatemala	200,000 lbs.

The total production on the basis of the foregoing figures for the Caribbean area, including Florida, is 12,463,000 pounds. However, there are reports that the spiny lobster is being produced in other areas of the Caribbean Sea also. Mr. A. R. Facey reports for 1942 for Jamaica, "I am of the opinion that these (crawfish) can be taken in certain localities off the South Coast of the Island in large quantities."

For the *Dominican Republic* it is reported the production of "Langosta" decreased from about 80,000 in 1921 to 23,000 in 1940 and then increased to 41,000 pounds in 1943.* Hopes for the development of this lobster industry are indicated by the report of Mr. Goodwin, First Secretary of the Embassy of June 25, 1949, concerning the establishment of the "Compania Pesquera Dominicana C. por A." He states, "The contract of the Dominican Fisheries Company indicates that the principal interest of the promoters will be in export of shrimp and lobsters (Langostas)."

A recent oral report of Mr. Robert Smith on *Venezuela* indicates that there are enough spiny lobsters to permit commercial exploitation there. One boat caught about 16,000 pounds per month, equivalent to 192,000 pounds per year. The total production for Venezuela is estimated to be about 1,000,000 pounds per year. A report on *Colombia*, published by the "Instituto de Fomento

* Report *Augal Rafael Merraro* of May 27, 1946.

Industrial" in 1942, indicates that Langostas are among the most important fishery products in Colombia. It is reported that on the island San Bernardo alone the production can easily be 10,000 pounds per month. Canned lobster meat is offered on this island in commercial quantities. In the region "from Punta De Don Diego to Tanganga" also an abundance of "Langostas" is reported. It is said that in the market of Tanganga 200 pounds of Langostas are sold monthly. The reason for the lack of commercial exploitation seems to be mainly the aversion of the native population to eating the meat of spiny lobsters. A report of Fiedler and Jarvis concerning the fisheries of the *Virgin Islands* also mentions spiny lobster fishing as one of the activities of the fishermen there.

Jarvis in his report on *Puerto Rico* fisheries also mentioned spiny lobster fishing as a part of the local fishermen's activities. Quantities are not mentioned in this report. However, Mary J. Rathbun in the publication "The *Brachyura* and *Macrura* of Porto Rico" of 1899 mentions that spiny lobsters are very abundant in Puerto Rico and in other parts of tropical America.

Summarizing the reports from the Caribbean area, it can be stated that the abundance of fish is such that the American imports, which were about 15,000,-000 pounds (landed weight), in 1948, could easily be covered by the Caribbean production alone. A total production up to 60,000,000 pounds is considered possible by persons who have fishing experience in Caribbean waters.

2. Methods of Production

In the *Bahamas*, fishermen bring their catch into Government weighing stations in small boats in which the lobsters are kept alive under damp sacks or in live wells. At the weighing stations they are maintained in live cars or kraals until licensed buyers arrive in their boats. The kraal consists of wooden s'at boxes floating in the sea. With a good tidal current to keep the water fresh, the lobsters will live for a week. If not overcrowded, and if supplied with conchs or fish heads for food, and if dead lobsters are removed, they will live several weeks. The buyer usually ships the lobsters to Miami, Florida, alive in damp sacks, or as tails, removed from the body and packed in ice. When shipped alive in jute sacks, they must be kept damp with sea water and well ventilated in order to prevent a rise in temperature. The tails, when separated from the body and iced, will keep fresh much longer. Until 1946, the largest buyer in the Bahamas operated a central plant for canning and freezing on one of the Islands and dispatched collecting boats with ice stores to the weighing stations. Canned meat and frozen tails were shipped to Florida. Today small quantities are being shipped by air.

In *Florida*, the lobsters are brought in alive by motor vessels and small boats to fish houses where they are placed on ice. Those in the best conditions are delivered immediately to retailers and restaurants. The remainder are boiled and returned to cold storage for holding or shipment to other states.

Cuban lobsters are taken by motor vessels mostly owned by outfitters or packers and leased to the fishermen. The owner receives 20 to 25 per cent of the catch and contributes to the fishermen's retirement fund. The catch is brought direct to the packing and canning houses. About 16 per cent of the catch is consumed in Cuba, approximately 22 per cent is exported as frozen tails, and the remaining 62 per cent is exported as canned tails. Only a small part of the catch is exported as cooked and refrigerated whole lobster.

The *British Honduras* industry has only recently produced any significant quantity for export. During 1936 and 1937 an attempt was made to can

lobsters, but this failed owing to insufficient supplies. During 1946, however, the master of a refrigerated vessel from the United States began to organize the fishermen and to ship deep frozen tails to Miami. As a result, the exports have begun to assume some importance, and the fishermen have been stimulated to greater endeavour and production. A second refrigerated vessel began work during the 1947 season shipping frozen tails by air to New Orleans. This has also brought about increased production, and has been instrumental in persuading the fishermen to use the more efficient trapping methods. Apart from this, small quantities have been exported at various times to Guatemala and to Tampa, but only recently has the steady market developed.

3. Methods of Transportation and Processing

The most primitive method of transporting lobsters is in the living state. Lobsters removed from the kraals are placed in jute bags and stored in the hold of the vessel. For trips of more than 24 hours duration it is necessary to dampen the bags with seawater from time to time. Dr. F. G. Walton Smith recommends the following procedures: "Sacks should be placed upon racks in order to allow ventilation and to prevent undue weight falling upon the bottom layer. It is important to provide adequate ventilation, since a rise of temperature may easily destroy the whole cargo.

"Since dead crawfish deteriorate rapidly, it is preferable to detach the tail, while the animal is still alive, and to pack alternate layers of tails and ice. This method results in a great reduction of spoilage, although it does not provide a product comparable to deep frozen tails.

"Deep freezing is far more satisfactory, and, so long as certain precautions are taken, the product may be eaten after six or seven months' storage without any loss of freshness. For deep freezing the tail should be removed from the body, since the remainder is not used and unnecessarily increases freezing and transportation costs. The tail weighs approximately $\frac{1}{4}$ to $\frac{1}{3}$ of the whole body. Before freezing the intestine is pulled out and all loose skin removed. Dehydration is prevented by leaving the tail in its shell and by dipping it into clean seawater *before* freezing. This produces a glaze, which effectually retards loss of moisture. The glaze should be renewed after two months in storage.

"The initial freezing should take place below minus 10° Fahrenheit, and after freezing the tails should be held at a temperature well below 10° Fahrenheit, preferably below 0° Fahrenheit. Precautions must be taken against thawing during prolonged periods of transportation, since the oxidation processes resulting in staleness are apt to occur at higher temperatures."

The canning procedure is the following: The crawfish are first inspected for freshness and are weighed. They are then cooked in steam retorts, after which the meat is separated from the shell and non-edible portions and is packed in cans, either with or without parchment lining. The cans are then closed, sterilized, cooled, labelled and packed.

Dr. Smith gives the following advice to canners: "It is important throughout to adhere to high standards of cleanliness, since the flesh of lobsters deteriorates very rapidly at normal temperatures. The time between receiving the live fish and canning it must be reduced to the minimum, and there is no magic which will transform lobsters already beginning to deteriorate when received into a good product. Only live lobsters should be accepted."

4. Prices of Caribbean Crawfish

The prices of Caribbean crawfish cannot be fully represented by the prices of spiny lobsters at the fishermen's level as reported by the United States Fish

and Wildlife Service. Prices paid in Florida are noticeably higher than prices paid on the Caribbean Islands and lower than the prices paid in California. This is exemplified by Tables 1 and 2. Table 1 shows the production and value of spiny lobsters in the United States 1939 - 1947 and in Florida 1939, 1940 and 1947. The last two columns of the table show the price per pound at the fishermen's level.

For 1941-44 inclusive no survey was made in the South Atlantic and Gulf Area and the 1940 figures were used in these years for this area. For 1946 and 1947 no survey was made in the South Atlantic and Gulf Area and the 1945 figures were used in these years for this area.

Table 2 shows the price paid to Cuban fishermen for live spiny lobsters for the years 1932, 1936, 1940 and 1946.

TABLE 1
SPINY LOBSTER PRODUCTION, VALUE AND AVERAGE PRICE PER
POUND AT FISHERMEN'S LEVEL IN U.S., 1939-1947

YEAR	PRODUCTION (LB.)	VALUE (DOLLARS)		AVERAGE PRICE PER LB. (CENTS)	
		Fla. only	Fla. only	Fla. only	
1939	1,649,000	359,200	232,000	24,382	14.07
1940	1,560,000	463,500	201,000	31,501	12.88
1941	1,769,000		234,000		13.23
1942	632,000		73,000		11.55
1943	762,000		125,000		16.40
1944	976,000		168,000		17.21
1945	1,256,000		273,000		21.74
1946	1,469,000		392,000		26.68
1947*	1,370,000	777,100	347,000	157,427	25.33
					20.3

*Estimated

TABLE 2
PRICES PAID TO CUBAN FISHERMEN FOR LIVE SPINY LOBSTERS, 1932, 1936,
1940 and 1946:

Year	I For 60 lbs. Paid	II Cents' Per Pound*	III Value of material of Raw Lobsters used in one Pound Frozen Tails** (Cents)
1932	.80	1.3	3.9
1936	1.35	2.2	6.6
1940	2.25	3.8	11.4
1946	4.50	7.5	22.5

* I divided by 60. **II multiplied by 3.

TABLE 3
EXPORT PRICES OF CUBAN LOBSTER MEAT (RAW) IN TRADE WITH U.S.

Year	I Quantity Exported	II Export Value (Dollars)	III Price per Kilogram* (Cents)	IV Price per Pound** (Cents)
1938	77,708	\$ 25,417	32.7	14.9
1939	83,781	32,805	39.1	17.8
1940	122,576	43,642	35.6	15.3
1941	430,485	139,015	32.2	14.6
1942	112,581	39,755	38.5	17.5
1943	163,656	79,035	48.5	22.0
1944	222,682	95,264	42.8	19.5
1945	117,988	40,808	34.6	15.2
1949				

* II divided by I. ** III divided by 2.2.

Table 3 shows the prices which were received by Cuban wholesalers who exported raw lobster meat to the United States. In 1940 the margin between the price paid to the fishermen for raw meat used in one pound frozen tails and the wholesaler's price was 3.9 cents or about 34 per cent of the fishermen's price. It may be interesting to note the margin which seems permissible in the freezing and selling of Cuban lobsters.

Wholesale prices for Cuban canned spiny lobster may be seen from Table 4.

The prices published by a large wholesaler in Chicago for Cuban lobster tails in 1949 are shown by Table 5. These are high under every possible consideration.

The prices documented by Bahamian exporters, are shown in Tables 6 and 7.

5. Production of Spiny Lobsters in South Africa

The crawfish is third in volume of fish caught in South African waters, and about 90 per cent is exported to the United States. Under conservation regulations there is a legal limit or quota of 6,000,000 lbs. of crawfish tails which may be canned or frozen annually for export. The Fisheries Development Corporation estimates that the tail of the South African crawfish is on the average 1/3 of the total weight, which means that the 6,000,000 lbs. export quota involves a total catch for export of 18,000,000 lbs. of crawfish. A further

TABLE 4
WHOLESALE PRICES OF CUBAN SPINY LOBSTER (CANNED)*

Year	Pounds Sterling	U.S. Cents Per Lb.
1932	6	40
1934	6	40
1936	6.50	43
1938	6.50	43
1940	6.75	45
1941	7.50	50
1942	10.15	67
1943	16.00	107
1944	20.00	133
1945	17.25 - 17.50 (17.38)	115
1946	17.25 - 21.50 (19)	127

*1932-1946 (per case of five-ounce tins or 15 pounds net).

TABLE 5
PRICES OF CUBAN LOBSTER TAILS FROZEN, 1949.

DATE	SIZE	¾ LB. EA.	½ - ¾ LB. EA.	¾ - 1 LB. EA.	6-8 oz. EA.	4-6 oz. EA.	4 oz. EA.	6 oz. EA.	OVER 1 LB EA.
Feb. 21-26	10 lb. Pkg.		.90		.80	.70			
Feb. 28-Mar. 5	10 lb. Pkg.		.94		.88	.78			
Mar. 7-12	10 lb. Pkg.		.94		.88	.78			
Mar. 14-19	10 lb. Pkg.		.95				.72		
Mar. 21-26	10 lb. Pkg.	1.10	.95				.75		
Mar. 28-Apr. 2	10 lb. pkg.		.95	1.10			.75		
Apr. 4-9	10 lb. pkg.		.95	1.10			.75		
Apr. 11-16	10 lb. pkg.		.95	1.05				.85	
Apr. 25-30	10 lb. pkg.			1.05					
May 2-7	10 lb. pkg.			1.05					
May 9-14	10 lb. pkg.			1.05					
May 16-21	10 lb. pkg.			1.05					
May 23-28	10 lb. Pkg.			1.05					
May 30-June 4	10 lb. pkg.			1.05					
June 6-11	10 lb. pkg.								1.05
Av.		\$1.10	\$.94	\$1.06	\$.84	\$.74	\$.74	\$.85	\$1.05

TABLE 6
BAHAMA EXPORTS - CRAWFISH FRESH OR FROZEN

Year	Pounds	Pounds Sterling	Dollars	U.S. cents Per Pound
1939	703,000	5,486	22,136.01	3.1
1940	789,600	13,130	52,979.55	6.7
1941	929,712	13,407	54,097.25	5.8
1942	710,192	15,910	64,196.85	9.0
1943	695,520	40,861	164,874.14	23.7
1944	740,768	46,028	185,722.98	25.0
1945	1,816,416	77,694	313,495.29	17.3
1946	1,229,648	43,281	174,638.84	14.2

TABLE 7
BAHAMA EXPORTS - CANNED CRAWFISH

YEAR	CASES	POUNDS	POUNDS STERLING	DOLLARS	U.S. CENTS PER LB.
1941	6,455	96,825	14,779	59,633.27	61.6
1942	12,428	186,420	25,173	101,573.06	54.4
1943	10,093	151,395	19,894	80,272.29	53.0
1944	2,498	37,470	7,800	31,473.00	84.0

2,000,000 lbs. of crawfish caught for the local market thus brings the gross annual catch in South African waters to 20,000,000 lbs. In addition 5,000,000 lbs. are being caught off the shores of South West Africa.

The South West African crawfish grounds are being developed rapidly. They lie for 45 miles along the coast to the north of Luderitz Bay from 5 to 25 fathoms.

The growth of the crawfish industry may be seen in the increase in annual catch from 15,000,000 lbs. in 1932 to 25,000,000 lbs. in 1947 and the growth of exports of canned and frozen tails from 3,566,000 lbs. in 1924 to 6,000,000 lbs. in 1947.

An agreement has recently been concluded among local exporters of crawfish tails whereby this commodity will be sold through one channel and exportation to the United States directed to a single organization, the gross return being pooled and averaged among exporters. The Fishing Industry Research Institute has agreed to undertake inspection of frozen crawfish tails prior to export.

6. Production and Marketing Methods of African Spiny Lobsters

In South Africa large vessels and larger crews are used in lobster fishing than in the Caribbean.

It is reported by the International Labor Office that the minimum wages of fishermen engaged in crawfishing are the following:

Skipper	£600 per annum
Driver	£450 per annum
Crew	£400 per annum

However, these minimum wages are mostly surpassed by the shares in which fishermen participate in the catch. The shares are different in enterprises which fish crawfish for freezing.

The canning firms supply the boats, gear and fuel. They guarantee fishermen three pounds per month throughout the year whether there is fishing or not. If the catch per month is not sufficient to make up the minimum, the firms stand the loss. The shares are divided in the following:

- 1 Share to the Boat Owner
- 1 Share to the Engineer
- 2 Shares to the Skipper
- 1 Share to each Crew Member.

In freezing enterprises the skipper and the engineer are paid a varying retaining fee and a share in the catch. Shares are calculated as follows:

- 2 Shares for the Boat Owner
- 1 Share for the Skipper
- 1 Share for the Driver
- 1 Share for the Crew as a whole.

In 1948 about 25 million pounds of crawfish were landed at an approximate value of \$2,917,000. The average price on which the shares of the fishermen were calculated was 11.6 cents per pound. The catching of the South African lobster is done exclusively by a government subsidized association.

7. Prices of South African Lobster

Tables 8 and 9 show the unit price per pound of frozen lobster and of canned lobster imported in 1932 - 1949 from the Union of South Africa. The average price of frozen lobster tails was 65.2 cents per pound and of canned lobster tails was 64.6 cents per pound. Since for freezing lobster tails about 3 pounds of raw fish for 1 pound of frozen fish are needed, the raw material, in the case of freezing, costs 34.8 cents, leaving a margin of 30.4 cents for freezing, storing, handling, transporting, and importing.

TABLE 8
QUANTITY, VALUE AND UNIT VALUE OF IMPORTS OF
SPINY LOBSTERS FROM THE UNION OF SOUTH AFRICA
1932 - 1948

YEAR	FROZEN			CANNED		
	POUNDS	VALUE	CTS. PER LB.	POUNDS	VALUE	CTS. PER LB.
1932				1,278	279	21.8
1933				1,071	317	29.6
1934	1,020	255	25.0	13,673	4,185	30.6
1935	131,595	19,850	15.1	116,707	30,697	26.3
1936	574,198	101,112	17.6	48,810	14,149	29.0
1937	1,694,487	349,088	20.6	103,222	33,351	32.3
1938	1,288,464	197,806	15.4	84,787	24,730	29.2
1939	1,587,270	298,931	18.8	25,023	7,246	29.0
1940	1,928,330	428,582	22.2	56,137	13,870	24.7
1941	2,751,911	644,890	23.4	121,250	34,398	28.4
1942	1,140,547	261,952	23.0	64,544	18,779	29.1
1943	462,800	144,369	31.2			
1944						
1945	433,600	165,841	38.2			
1946	2,564,345	1,136,316	44.3			
1947	2,236,780	1,485,076	66.4	1,200	705	58.8
1948	2,657,178	1,733,763	65.2	722,151	466,417	64.6

SOURCE: Bureau of Census

TABLE 9
IMPORTED IN U.S. FOR CONSUMPTION, JAN. - JULY, 1949
LOBSTERS NOT CANNED

	LOBSTERS NOT CANNED		LOBSTERS CANNED	
	QUANTITY LBS.	VALUE DOL.	QUANTITY LBS.	VALUE DOL.
January	688,253	303,907	36,765	35,281
February	803,528	322,375	17,742	16,279
March	1,414,650	818,263	29,404	24,379
April	433,172	311,334	19,924	19,394
May	782,837	524,363	10,263	8,830
June	697,224	519,161	1,107	1,137
July	105,028	52,728	186,580	128,343
TOTAL	4,924,692	2,852,131	301,785	233,643
Av. Price per Pound	57.9 cents		77.4 cents	

Source: Department of Commerce "United States Imports for Consumption of Merchandise" various months.

For canning, about 4 pounds of raw fish are needed for 1 pound of canned fish. The raw material costs to the canneries were, in 1948, about 46.4 cents, leaving a margin of 18.2 cents for canning, handling, transporting, and importing. Obviously, this margin differential has not changed in 1949 although in 1949 the average prices of imported lobster from South Africa have increased to 80.1 cents frozen lobster tails and 77.8 cents canned lobster per pound (see Table 10). In Table 11, average wholesale prices for New York in November, 1948 and average retail prices in eastern United States cities are mentioned. These prices are especially interesting in comparison with Table 12, showing the prices of Maine lobster on the producer and two distribution levels.

TABLE 10
QUANTITY, VALUE AND UNIT VALUE OF AFRICAN LOBSTERS NOT
CANNED AND LOBSTERS CANNED IMPORTED IN U.S.
FOR CONSUMPTION — JANUARY - JULY 1949

LOBSTERS NOT CANNED 1949	QUANTITY	VALUE	AVERAGE PRICE PER POUND
January	34,900	\$ 27,765	
February	.....	.....	
March	423,120	337,405	
April	311,000	246,658	
May	200,000	159,111	
June	513,600	415,939	
July	.....	.....	
	<u>1,482,620</u>	<u>\$1,186,878</u>	80.1 Cts.
LOBSTERS CANNED 1949			
January	20,682	17,590	
February	.....	.....	
March	14,436	10,356	
April	2,400	1,251	
May	.....	.....	
June	.....	.....	
July	.....	.....	
	<u>37,518</u>	<u>\$29,197</u>	77.8 Cts.

SOURCE: Quantity and Value obtained from "United States Imports for Consumption of Merchandise" printed by the Department of Commerce for various months.

TABLE 11
ESTIMATED AVERAGE VALUE IN U.S. CENTS PER POUND OF
AFRICAN LOBSTER TAILS AT DIFFERENT LEVELS OF
DISTRIBUTION - NOVEMBER, 1948

<i>Average Price All Exports at Exporter Level from the Union of South Africa</i>	<i>Average Price U. S. Imports at U. S. Im- porter Level</i>	<i>Average Whole- sale Price at New York, N.Y.</i>	<i>Average Retail Price in Eastern U.S. Cities</i>
CENTS PER LB.	CENTS PER LB.	CENTS PER LB.	CENTS PER LB.
November, 1948 45.31	79.52	100 ³	120 ³

1. SOURCE: Interpolated from F.A.O. Fisheries Yearbook - 1947.
2. SOURCE: Bureau of Census.
3. SOURCE: U. S. Fish and Wildlife Service.

TABLE 12
AVERAGE VALUE IN CENTS PER POUND OF MAINE LOBSTERS AT
DIFFERENT LEVELS OF DISTRIBUTION - NOVEMBER, 1948.

	<i>Average Price to Producer in Maine</i>	<i>Average Wholesale Price at New York City, Nov. 15, 1948</i>	<i>Average Retail Price at New York City Nov., 1948</i>
	CENTS PER LB.	CENTS PER LB.	CENTS PER LB.
November, 1948	42.7	78*	105*

* ESTIMATED.

SOURCE: U. S. Fish and Wildlife Service.

The higher price received for frozen South African lobsters is due to the superior quality of the product. The lobster tails coming from South Africa are individually wrapped in cellophane before freezing. They are graded into sizes. The sizes are ½ lb. to ¾ lb., ¾ lb. to 1 lb., and over 1 lb. They are packed in flat slat boxes holding 20 pounds each. The American market of South African lobster is strictly controlled by the South African Rock Lobster Association Inc., 8 West 40th Street, New York 18, New York. The three grades of lobster

TABLE 13
WEEKLY AVERAGE WHOLESALE PRICES OF AFRICAN LOBSTER TAILS*
FOR DIFFERENT SIZES AS INDICATED AT
CHICAGO, ILLINOIS
FEBRUARY 21 - OCTOBER 15, 1949

DATE	LARGE (Dol. per lb.)	MEDIUM (Dol. per lb.)	SMALL (Dol. per lb.)	SIZE NOT SHOWN (Dol. per lb.)
Feb. 21-26	...	...	...	1.10
Feb. 28-Mar. 5	...	...	...	1.10
Mar. 7-12	...	...	...	1.15
Mar. 14-19	...	...	...	1.15
Mar. 21-26	...	...	...	1.15
Mar. 28-Apr. 2	...	...	...	1.15
Apr. 4-9	...	...	...	1.15
Apr. 11-16	...	...	...	1.15
Apr. 25-30	...	...	...	1.15
May 2-7	...	...	...	1.15
May 9-14	...	...	...	1.15
May 16-21	1.15	1.10	1.05	...
May 23-28	1.15	1.10	1.05	...
May 30-June 4	1.15	1.10	1.05	...
June 6-11	1.15	1.10	1.05	...
June 13-18	1.15	1.10	1.05	...
June 20-25	1.15	1.10	1.05	...
June 27-July 2	1.15	1.10	1.05	...
July 5-8	1.15	1.10	1.00	...
July 11-16	1.15	1.10	1.00	...
July 18-23	1.15	1.10	1.00	...
July 25-30	1.10	1.00	.97	...
Aug. 1-6	1.10	1.00	.97	...
Aug. 8-13	1.05	.98	.95	...
Aug. 15-20	1.05	.98	.95	...
Aug. 22-27	1.05	.98	.95	...
Aug. 29-Sept. 3	1.05	.98	.95	...
Sept. 5-10	1.10	.98	.95	...
Sept. 12-17	1.10	1.00	.95	...
Sept. 19-24	...	1.00	.95	...
Oct. 10-15	1.10	1.00	.95	...
AVERAGE	\$1.12	\$1.05	\$.99	\$1.14

* IN 20-POUND BOXES.

SOURCE: "Morris Market Bulletins" furnished by Morris Fisheries, Inc.

graded in South Africa are reflected in the wholesale price in the United States according to Table 13, which was made up on the basis of "Morris Market Bulletins" furnished by Morris Fisheries, Inc.

3. Organization of the South African Lobster Industry

While the Caribbean spiny lobster industries operate nearly exclusively upon their own capital and investment, the South African lobster industry is largely supported by a government corporation, the Fisheries Development Corporation of South Africa, Ltd. The Fisheries Development Corporation, the industry's alternative to state control on the one hand and unregulated free enterprise on the other, was established under the Fishing Industries Development Act (No. 44 of 1944) as a public utility corporation with a capital of £1 million (about \$4 million); its major purpose was to advise regarding the development of South African fishing harbors in conjunction with the South African Department of Commerce and Industries and the Railways and Harbors Administration, to assist private interests in developing the industry along orderly and rational lines, and to provide social improvements such as housing. Aside from such social services, its major contribution has been in consolidating and unifying the industry through such mergers as those discussed in this report.

The South African Government's Minister of Economic Affairs appoints the Directors of the Corporation and the Parliament must approve investments of funds. The Fisheries Development Corporation has in the past year been advising regarding harbor improvements in the Cape Province as well as conducting experiments in oyster culture at Knysna and establishing a Fisheries Research Institute. Much progress has been made in extending housing and social facilities.

The "A" shares of the Corporation are used on a non-profit basis for social services; the "B" shares are invested in existing commercial fishing firms to obtain guiding but not absolute control. One or more representatives of the Fisheries Development Corporation sits on the Boards of such firms; the Corporation handles social services and gives advice in exchange for returns on its share holdings.

The Fisheries Development Corporation holds important financial interests in the following fishing companies:

- Lambert's Bay Canning Co., Ltd.
- Stephan Bros. (Pty) Ltd.
- Ovenstone Holdings
- South African Sea Products (Pty) Ltd.
- Ocean Products (Pty) Ltd.
- Laaiplek Fisheries, Ltd.
- North Bay Canning Company
- St. Helena Bay Fishing Industries, Ltd.
- Southwest African Fishing Industries, Ltd.

Of these subsidiaries the following corporations are interested in the crawfish or spiny lobster industry.

The *South African Sea Products, Ltd.* holds 80 per cent of the South African crawfish export quota and thus controls 80 per cent of the export of frozen crawfish, the chief market for which currently lies in the United States. The company operates a large modern crawfish freezing plant, and a vitamin oil extraction plant utilizing shark livers at Hout Bay. Its major subsidiary companies, resulting from a recent merger, are:

- Stubbs Fisheries, Ltd., handling fresh fish at Capetown
- Trans-African Fisheries, Ltd., at Hout Bay
- Hout Bay Canning Company (1920), Ltd.
- Swerling and Levin, Ltd., dealing in smoked fish at Capetown
- Duikersklip Fisheries, Ltd.
- Trautman Bros.

The *South West African Fishing Industries, Ltd.*, which is called SWAFIL, operates through its subsidiaries a crawfish freezing plant, a crawfish cannery, a reduction plant, a smokery and a small fleet of fishing boats, all at Luderitz Bay, South West Africa; it was only recently formed to incorporate the following subsidiaries:

Table Mountain Canning Co., Ltd., Conducting crawfish canning at Luderitz Bay.
 Angra Lobster Cannery (Pty) Ltd., at Luderitz Bay
 Cape Lobster Canning Company, Ltd., at Luderitz Bay

The *Ovenstone Holdings* is interested primarily in crawfish canning at Port Nolleth in the Cape Province, but is presently expanding into pilchard canning and reduction—possibly also tuna canning at Walvis Bay.

The merger of the above six firms involves the assumption by the Lambert's Bay Canning Company of a majority interest in the remaining five. It is understood that each company will retain its present name and registration.

Among the independents the African Fish Canning Company and the North Bay Canning Company should be mentioned.

9. International Trade in Spiny Lobster (Caribbean and South African)

The United States plays an important part in the international trade of the Caribbean and the South African spiny lobster. As far as the Caribbean lobster is concerned, nearly all exports go to the United States and the export is about 90 per cent of the total production. Of the South African production about one half goes to the United States; about 10 per cent is consumed in South Africa and the rest of 40 per cent goes to other countries, mainly to the motherland. The following Table 14 shows the development of United States imports of fresh, frozen, and cooked spiny lobster 1945 - 1948.

TABLE 14
 U.S. IMPORTS OF FRESH, FROZEN AND COOKED SPINY LOBSTERS
 (WHOLAS AND "TAILS")
 1945 - 1948

COUNTRY OF ORIGIN	1948 LBS.	% OF TO- TAL 1948	1947 LBS.	1946 LBS.	1945 LBS.
Mexico	2,052,491		1,920,442	1,671,234	1,072,935
Honduras	6,606				
Br. Honduras	136,264		157,538	79,220	
Nicaragua	406				
Bahamas	1,197,821	58.7	1,371,701	1,271,677	1,487,634
Cuba	1,150,792		425,201	250,100	353,881
Jamaica	7,150		53,376		
Leeward Islands	2,085		13,587	3,500	
Curacao			1,878		
Fr. W. Indies			7,040	7,004	
Australia	514,290		97,482		
		7.0			
New Zealand	30,410		29,256		
U'n of S. Africa	2,657,178	34.3	2,236,780	2,564,345	433,600
TOTAL	7,755,493	100.0	6,314,281	6,847,080	3,348,050

SOURCE: U. S. Fish and Wildlife Service.

Table 15 shows the imports of canned spiny lobster meat in the United States 1945-1948.

TABLE 15

**U.S. IMPORTS OF CANNED SPINY LOBSTER MEAT
1945 - 1948**

COUNTRY OF ORIGIN	1948 LBS.	% OF TO- TAL 1948	1947 LBS.	1946 LBS.	1945 LBS.
Cuba	294,546	28.5	122,359	461,529	459,375
Guatemala	1,238				
New Zealand	19,175	1.8	12,825		
U'n of S. Africa	722,151	69.6	1,325		
China	600	0.1			
TOTAL	1,037,710	100.0	136,509	461,529	459,375

SOURCE: U. S. Fish and Wildlife Service.

The imports of both canned lobster on one side and fresh and frozen lobster on the other side nearly doubled 1945 - 1948. While the imports of fresh and frozen spiny lobster in this period from Mexico almost doubled and from Cuba about tripled, the imports from the Union of South Africa increased about 600 per cent. As far as canned spiny lobster meat is concerned, the imports from Cuba 1945 - 1948 decreased about 50 per cent while the imports from the Union of South Africa increased about 700 per cent.

10. Conclusion

In the United States market Caribbean spiny lobster unquestionably suffers great competition from South African lobster. The stronger competitive position of the South African lobster is due to differences of quality in the shipped product, and of packaging and marketing. These differences can be overcome by the following remedies:

(a) Fishermen in the Caribbean area must receive a higher price to encourage a constant supply.

(b) In all production areas the spiny lobster has to be graded, and properly packed.

(c) Transportation has to be accelerated and directed to central marketing places in the United States.

(d) The Caribbean producers should establish a central sales organization through which quality control can be properly handled.

(e) Abnormal margins between fisherman-producer on one side and exporter-importer on the other side must be changed to more realistic margins based on actual additions of value.

If new machinery is considered necessary for proper handling, especially grading and freezing, the question will arise whether some assistance can or should be given under the Point IV Program of the President of the United States as mentioned in his "Inaugural Address of 1949." Obviously fishermen in the Caribbean Area need the "know-how" possessed by the South African lobster industry. Whether climate, educational standards and ethnographical factors permit the successful operation of an American technological mission to the Caribbean is a question, the answer to which is a prerequisite beside the consideration of the political situation in the respective Caribbean countries.

Trends In Fish Production And Marketing

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LIKE TRUE LOVE, the course of the commercial fisheries rarely runs smooth. After combating production, man power, and material problems previously inconceivable in nature, variety and magnitude during the war years, the fisheries temporarily enjoyed the luxury of a seller's market. Unfortunately, that condition no longer exists and the transition to a buyer's market has been practically completed.

Coincident with this change has come a very definite change in the food purchasing habits of the American consumer. We have witnessed already a great number of these changes, such as the definite trend toward increased concentration of populations in the cities at the expense of the rural areas, the increased income and spending potential within the country, the introduction of self service stores in the cities, the rapidly expanding use of frozen food cabinets in the stores, speedier and wider distribution facilities, rural frozen food locker plants, greater advertising activities in food lines, and the greater variety of foods that are available.

Competing food industries are actively and earnestly striving for this domestic market and it behooves the fishing industry to keep pace with these groups if it wishes to maintain or increase its sales.

We may as well accept the fact that today Mrs. American Housewife is the boss insofar as purchasing potency is concerned. Upon the attitude she has toward seafood products largely depends the future destinies of the commercial fisheries. More and more women are working, with the result that their time is becoming more important and they do not use their kitchens as much for the extensive preparation of food. The housewife expects more and more of these duties to be taken over by the various marketing agencies. Products which have been partly or wholly pre-processed help the housewife expedite her work in the kitchen. Many such products are now available, and although they may involve a higher cost per unit of nutritive value, the housewife is generally willing to pay this additional cost insofar as her kitchen time is saved.

The fisheries have no monopoly on the protein food market, but they have the advantage of being able to provide a greater variety of food items than other competing groups. But because of this variety they have a more difficult job of merchandising. There is a growing trend toward pre-packaging for self service markets. While original developments in meat pre-packaging have been done in the back of retail markets the trend now seems to be toward packaging at the packer level. The fishing industry in some of the large centers has been doing this for many years and in this regard is ahead of meats. Retail store packaging of fishery products has not or cannot be expected to develop to the degree that meats have, but nevertheless a trend of self service will require that more and more packaging be done by packers of fishery products, particularly in those areas where most fish are now sold either as they come from the water, or very little further processed, in order to maintain or develop a place in markets.

Direct contact with the consumer is being lost as the trend towards self service grows. In this form of marketing it is important to realize that the housewife herself makes the final decision. The industry can play an important part in her decision through advertising and sales promotion, particularly at the

point of sale. Every day scores of people buy their groceries and go without purchases of fish because there is nothing informative or suggestive to stimulate buying.

With pre-packaging, the type of package becomes increasingly important. Today's shopper doesn't like to play "hide and seek." The product that quickly shows its value at the point of sale appeals to today's efficient shopper. In addition to reminding her what she wants to know about size, color, quality, and price, it often reminds her of a need or suggests a use. Alert retailers throughout the country are realizing more and more the sales power of visibility and are prone to give better packaged products the preferred display spots, for where the product is displayed plays an important part in its sales turnover.

Proof of the value of a neat, attractive appearance comes in a report concerning the packaging of rice, dry beans, and peas which was made by the Production and Marketing Administration of the Agriculture Department in 30 key cities. Here is what they found: Grocery dealers increasingly prefer packages of transparent film. The solid carton and craft packages seems to be losing popularity to the window front or all cellophane types. One reason for merchant preference for "see through" packages is the appeal to the consumer. It helps sales to let the shopper see the product since she does a lot of buying on impulse. Incidentally, the trend is to package much higher quality in the transparent packages for reasons that are obvious.

The fruit and vegetable industries, whose problems of marketing closely parallel those of the fishing industry, have made effective use of dealer service in promoting sales. Manufacturers of other products have also applied this practice for many years. Increased sales and more satisfactory relationships have been accomplished through dealer service. The importance of promoting new and more efficient marketing techniques at the retail level to make clear to retailers themselves the critical nature of their vital part in the marketing channel is widely realized by agricultural interests. In order to maintain their competitive position, fishery industries will also have to enter this field of retail and merchandising education. However, they will have the advantage of experience gained by various agricultural interests.

Actually, the fishing industry has opportunities which, if properly nurtured, can assure it of markets of sufficient magnitude as to guarantee it greater security. These are not, however, markets which can be obtained just by the asking. They will require development, and because of their very nature, results will only be in relation to the efforts expended toward their development. What are these markets? Where do they exist? And what processes must be taken to cultivate them?

During 1950 more than one billion school lunches will be served under the National School Lunch Program for which more than two hundred million dollars worth of foods will be required. As of November, 1948, nearly eight million children in 48,000 schools in the United States and its territories have benefited from the Federally supervised school lunch program. If fish constituted one-fifth of these billion lunches, the school program alone would have required fifty million pounds (round weight) of fishery products during 1949. The importance of this field becomes even more apparent when one realizes that if a desire for fishery products can be instilled in these children during their formative years their purchasing plans will naturally include these items when they mature and develop into the homemakers of this country.

A recent survey conducted by the Bureau of Human Nutrition and Home Economics should also be of keen interest to all members of the fishing in-

dustry. This survey, conducted in 68 cities selected at random throughout the United States, indicated that only 56.6 per cent of the families contacted use fishery products in their household menus. If we assume that the present per capita consumption of seafood in the United States is 11.5 pounds per year (edible weight) the potential consumption rate, based on this survey, can be increased by 43 per cent. This could result in an additional market for over 2.5 billion pounds of fish (round weight) per year. This not only exceeds the present productive capacity of this country, but would also enable us to absorb imports from foreign countries far beyond their present capabilities.

In addition, according to the Census Bureau, the population of this country is increasing at the rate of one million persons every five months. Also, the Census Bureau reports there were twelve million marriages in this country between 1940 and 1946 and it is estimated that by 1950 an additional 6.5 million marriages will have taken place. By that date, 1950, better than 40 per cent of all marriages in this country will date from the period between 1940 and 1950. Most of these new homemakers have had little or no training in the preparation of fish and shellfish and are constantly seeking ways to serve tasty foods to their families. An effective consumer educational program could well result in these new homemakers constituting additional purchasers of fishery products.

To the credit of the industry much is being done. The current growth of such items as the breaded and veined fantail shrimp, devilled crabs, and ready to fry fish are good examples of what the future holds. The almost complete change to frozen packaged shrimp is another. As a matter of fact, only one shipment of fresh shrimp was reported as arriving in Chicago last year, and of this two-thirds were later frozen. Crab meat dated prominently on the can gives the consumer the feeling of quality security she needs. This same dating feature also applies to fresh shucked oysters. She is also attracted toward specialty items such as smoked shrimp, shrimp cocktails, etc., and it is probable that the consumer will expect her shrimp to be deveined in the future since she recognizes the advantages of deveining but doesn't want to be put to the inconvenience of doing it herself.

Unfortunately, few of the southern fish take well to filleting. For that reason it appears improbable that any large scale developments will take place in this field. True, there will always be a market for the quality fresh and frozen southern fish since the bulk of this catch is made at a time when the northern fisheries are stagnated because of climatic conditions. However, this advantage is slowly disappearing since freezer stocks of northern fish insure an almost year around supply. Furthermore, as the consumer finds pre-processed food are available, she will be less inclined to buy the generally more expensive southern whole fish. Actually, even the old standby and reliable southern markets are handling and selling increased amounts of northern fillets at the expense of southern fresh fish.

With this in mind then it appears only logical that fishery items pre-processed and pre-packaged on the producer level constitute the future bright star of the fisheries. With this transition, certain other economic conditions would probably result. New plants, sanitary in operation, would be producing laboratory tested products. Plant employment could be more regular since raw stocks could be frozen and held to fit the production line requirements. Price for raw stock could be better stabilized since over-production during high seasons could be frozen and held. Definite trends along these lines are already apparent. Improvements in the esthetic appeal of fishery products and manu-

facturing plants and localities in which they are situated, as well as the characteristics of the products themselves, are being made but slowly.

As competition increases and the producer's margin is reduced, the industry will probably find itself being forced to adopt more economical production practices. Taking advantage of everything that is known about preventing waste in processing plants can pay big dividends. Spoilage and waste can well be given a greater share of the southern producer's attention. Scrap fish, caught in connection with the vast shrimp trawling operations, offer potential sources of raw material for reduction into fish meals and the recovery and condensation of solubles. In so doing, fishermen's incomes would be supplemented, while processors could probably reduce costs of major profit items by utilization of these present waste products. Among the products which might be profitably extracted from the wastes are animal foods, protein hydrolysates for convalescent feeding, amino acids, adhesives, chemicals, drying oils, and chemical products. Research in governmental and private laboratories is proceeding along these lines and the time may not be too far distant before such wastes will have many uses.

Truly the fisheries are at the merchandising crossroads. The fishing industry has rarely been characterized by initiating outstanding advances in processing and merchandising. Now, however, it is a matter for the fishing industry to adjust itself to modern consumer demands and efficient operating practices or find itself out-priced, out-packaged, out-retailed, and out-itemed from the food market.

Packaging And Marketing Airborne Seafoods

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Consumption of Fresh Seafoods

AIR CARGO STUDIES at Wayne University indicate that people in this country would like to consume an additional one-half billion pounds of strictly fresh fish. A goodly portion of this 62 per cent increase above present consumption could be achieved if improved methods of producing, cooling, packaging, transporting and merchandising were employed to bring to market in prime condition the products of the sea.

The United States can hardly be called a nation of fish eaters when per capita consumption of fresh fish—as distinguished from processed fish—amounts to only 6.9 pounds annually. Even with the inclusion of canned, smoked, and salt fish and the sportsman's catch thrown in for good measure, our annual per capita consumption of 14.8 pounds is not impressive. In comparison with fish consumption in other countries the United States ranks fourteenth among the nations although in production it is exceeded only by Japan. Furthermore, this low national average consumption is by no means evenly distributed. Fish is eaten most nearest its sources of supply. Residents of tide water states eat fresh fish well above the national average. The states of Massachusetts and New York, for example, eat an average of approximately 13 pounds per capita.

As the distance between the consumer and the source of supply increases, consumption drops off until we find seven West North Central states averaging

only 3 pounds per capita and Oklahoma and Idaho down to approximately 2 pounds.

In general it may be stated that the feeble showing of fresh fish on the American menu is due to poor merchandising and the adverse effect on *quality* of existing methods of packaging, handling, transportation and temperature control.

The *quality* factor must be placed at the top of the list, for no amount of smart merchandising or of consumer education as to the selection and preparation of fish can atone for poor market quality.

Properly speaking, there is hardly such a thing today as a strictly fresh salt water fish at inland markets. As a rule the "freshest" salt water fish served in a midwestern home is 8 to 12 days old. Unlike meat, which requires a period of aging and therefore gains in flavor and texture with the passage of time, fish begin to deteriorate immediately upon leaving the water. Then, too, throughout the period of storage, shipping and marketing in the conventional manner, melting ice leaches out valuable minerals, proteins and flavor. Few species retain their high sea flavor and freshness beyond six or seven days. After that period of time they begin to develop stale odors.

Objectionable odors given off in the cooking of stale fish, or that remain on the housewives' hands from handling, retard consumption and account for some of the public disdain toward fish. Evidence of this is found in a national advertisement that recently used a housewife's fish cooking dilemma as the theme for its copy. In cartoon fashion this advertiser, one of the "good-air" makers, presented the happy solution for objectionable odors that develop in homes when fish are cooking. The advertisement pictured the housewife in a gas mask saying "Guess I better spend the evening in my gas mask." Next frame shows the fish cooking in an open frying pan on top of an electric stove. At this point, hubby arrives on the scene holding his nose and saying, "I used to think I liked fish—but phooey!" "I know, dear," said wife, "but what can I do??" Meditating she says to herself, "I guess I just can't cook fish any more, Hal always complains." In the next frame a neighbor informs the worried wife about the product that rids the home of objectionable odors. On a subsequent evening hubby comes home and not smelling anything cooking remarks, "Going to eat out tonight, Irene? I don't smell dinner cooking." "Ah, ha," replies Irene, "WE HAVE FISH, but you can't smell it, thanks to Good-Aire."

Does the fishery industry know how many persons are not eating fish because its preparation and cooking develops objectionable odors in the home? It is probable that a very considerable number of households in this country are being robbed of the pleasures of eating fresh fish not only because it usually lacks its original high sea flavor, but also because fish that is not fresh fouls up the house in preparation and cooking.

On this home odor problem there is some first-hand experience to report. The writer has been in the kitchen countless times while fresh fish, shipped by air, have been cooking. Only a little over a week ago, for example, 150 pounds of fresh shrimp were shipped by airfreight from Sea Island, Georgia. These shrimp were cooked at a private club in Detroit. In the small kitchen at the time these shrimp were cooking the odor that came off while they were in the boiling water was no more noticeable than if they had been cooking rice.

Experiences such as this have convinced the writer that you can ship into Detroit and other inland markets strictly fresh seafood *if* it is promptly pre-cooled, properly packaged and shipped quickly to its destination by airfreight.

Ten experimental air shipments of shrimp have been made. These were kitchen-tested on each of several days after their arrival. Likewise 65 experimental air shipments of other kinds of seafoods have been made—salmon from Alaska, dungeness crabs from Washington, oysters from Virginia, pompano from Florida, brook trout from Montana and Colorado, shad from Connecticut, and lobsters and haddock from Massachusetts, etc.—in all a total of approximately 75 experimental shipments to develop and test the principles underlying a successful packaging and air transport operation in seafoods.

It is not meant to give the impression that the last word has been said on methods of packaging and airfreighting seafoods. Rather, a modest beginning has been made and perhaps the beginning paragraphs have been written in the chapters yet to be produced on the possibilities in new methods of packaging and transporting these perishable products.

Commercial Operations

When the study "Markets for Airborne Seafoods" was begun back in 1945, no known air shipping of seafoods was then under way. Since this study, which has included 75 experimental air shipments of seafoods, various air carriers have undertaken to develop traffic in fresh fish. Most notable in this connection are the experiences of American Airlines in their shipments of lobsters and other kinds of seafoods from Newfoundland into Boston, New York, Cleveland and other inland markets, and Meteor Airlines operation from the Great Lakes into New York. Other carriers such as United Air Lines, Slick Airways, Chicago and Southern Airlines and Eastern Airlines also have shipped seafoods to some extent.

Perhaps the most significant airfreight operation in fresh fish at the present time is that of Meteor Airlines which is flying fresh fish from Michigan's Great Lakes into New York City. Last July representatives of the several interests involved came out to Wayne University after reading the research reports. Soon after this conference, 50,000 to 75,000 pounds of whitefish, pickerel and other fresh water species were being flown weekly from ten different points in the Great Lakes area. The fish are received in New York by fresh water wholesale fish receivers and the Great Atlantic and Pacific Tea Company.

The operation runs something like this: the fish are taken from the Lakes today, eviscerated, precooled (but not adequately), placed in light wooden wire bound containers, lightly iced (5 pounds of ice to 50 pounds of fish), trucked to the airport and loaded during the early part of the night—130 boxes per plane load. The shipment is then flown to New York where it is unloaded by means of a conveyor utilizing gravity to move each individual box of fish from the plane into the waiting truck. The fish are then trucked to the receivers located in the Fulton market in New York City so as to arrive between 6 and 7 a.m., and from there they move into retail outlets. In other words these fish are on the retail market 24 to 28 hours after being taken from the water.

Previously nearly all of the fresh fish from the Great Lakes moved into New York via railway express. With the introduction of airfreight, one full market-day is saved and added to the commercial life of the product. And one day, especially if it is the fourth to the sixth day, can mean a great deal commercially because of its effect upon the eating quality of the fish.

The costs connected with this significant operation are of interest. In general the costs per net pound of fish via airfreight are reported by Mr. Joseph Scott, coordinator of the operation, to be identical to the costs of shipping by rail express. Broken down these costs are as follows: \$1.00 per hundredweight for

packaging; \$1.00 for trucking (50c at origin and 50c at destination); \$4.00 per hundredweight for the airline haul, airport to airport—a total cost of \$6.00 per hundredweight.

Of course, the economics of the situation are not always so favorable to the air carrier and the fishery industry as is the case in the Great Lakes-New York operation. In this instance, the air carrier has specialized in a short-haul operation from the East Coast into Detroit and other nearby cities. Traffic out-bound from New York has far exceeded traffic for the return trip. Generally, the carrier was operating with very light loads or no loads at all on the return trip from the West to the East. Traffic in fresh fish from the Great Lakes, therefore, provides a full load for the return trip. Since it costs very nearly as much to fly a plane empty as loaded, it is obvious that even a low rate operation could be very beneficial to the carrier in this instance.

There are other situations over the country in which the economic factors seem to fall into the lap of the air carrier in an advantageous manner. American Overseas Airlines, for example, have a number of planes daily crossing the North Atlantic via Newfoundland to the States. By the time these planes reach Gander in Newfoundland, they use up several thousands of pounds of gasoline which must be counted as a part of their total permissible load in their taking off, let us say at Shannon. Being able to carry approximately 1,000 less gallons of gasoline, or 6,000 pounds, from Gander on to New York, makes room for 2 to 3 tons of cargo on this last leg of the trip. When it is realized that there are 20 such crossings of the Atlantic each day, this means that 50 to 100 tons of seafood could be carried daily from Newfoundland down to Boston and New York with but very little extra expense to the airline.

Other air carriers may find that they have a similar economic situation in their operation. For example, Pan American flying from the South may have unused capacity from the Dominican Republic or Cuba into Florida and from points in Alaska to Seattle.

If an airfreight operation in seafoods is to be successful, however, there must be something in addition to air cargo space. Especially must there be an abundant supply of seafood *suitable* for air shipment.

Propensity of Seafoods to Air Shipment

Factors which weigh with force in the determination of the kinds of fish most amenable to air shipment are consumer preference, price per pound, volume of catch, seasonal variation in the catch, and rate of perishability. All of these factors were used in devising the formula to measure the disposition of various species of seafoods to air shipment.

Consumer preference surveys conducted in Kansas City, Chicago and Detroit gave consumers an opportunity to express their preferences for various species of fin and shell fish most desired in air shipment. Top ten on the list were shrimp, pompano, red snapper, salmon, lobsters, swordfish, oysters, sturgeon, crabs and scallops—70 per cent of which are found in the waters of the Gulf and South Atlantic.

Price per pound was given considerable weight in the propensity formula because previous experience in predicting air cargo potentials showed that relatively high priced perishables benefit doubly from high speed transportation. Rate of perishability and seasonal variation in the supply also weighs importantly.

Using a weighted formula nearly 100 species of fish were given an air propensity rating and grouped into three classifications of air propensity: "excellent," "good," and "fair."

The species judged most likely to lead the air cargo parade are sturgeon, brook trout, pompano, swordfish, whitefish, oysters, crabs, lobsters, scallops, clams, shrimp, flounder and red snapper. All of these climbed into the top propensity bracket.

It is significant that almost all (95 per cent) of the total annual catch of shellfish rate "excellent" on the propensity index and the remaining 5 per cent rate "good." In this field lies a vast potential for airfreight. The air transporter of seafoods should be interested particularly in those species which show highest propensity to air carriage and that, at the same time, are caught in sufficient quantities to provide worthwhile loading over a long season of time.

Total annual production of seafoods in continental United States judged "excellent," or highly amenable to air shipment, is 433 millions of pounds. Not all seafoods are adapted to air carriage at this time. Of those that are adapted to air shipment, the highest concentration is to be found in the waters of the Gulf, Caribbean and South Atlantic. *Fifty per cent of the seafood production in continental United States having a high propensity to air carriage is found in these southern waters.* Seafood production in this area strongly inclined to air carriage amounts to upwards of 215 millions of pounds, most of which is shellfish, shrimp accounting for upwards of 70 per cent of the total.

Fresh fish and shellfish production by areas and air propensity classes for continental United States is found in Table 1. A breakdown of fresh fish and shell fish production for the South Atlantic and Gulf by air propensity classes appears in Table 2.

TABLE 1

SUMMARY OF AVERAGE 1939-1941 CATCH OF FRESH FISH AND SHELLFISH
BY PRODUCTION AREAS AND BY AIR PROPENSITY CLASSES *
(IN THOUSANDS OF POUNDS)

PRODUCTION AREA	EXCELLENT		GOOD		FAIR		TOTALS	
	POUNDS	PER CENT	POUNDS	PER CENT	POUNDS	PER CENT	POUNDS	PER CENT
New England	38,258	8.8	74,328	18.2	498,958	57.1	611,544	35.64
Middle Atlantic	29,898	6.9	33,556	8.2	44,249	5.1	107,703	6.28
Chesapeake Bay	87,133	20.1	20,390	4.9	44,218	5.1	151,741	8.84
South Atlantic & Gulf	215,233	49.7	84,213	20.6	5,351	.6	304,797	17.77
Pacific	34,472	8.0	77,025	18.9	110,291	12.6	221,788	12.93
Great Lakes	25,512	5.9	41,117	10.1	13,555	1.6	80,184	4.67
Mississippi River and Tributaries	5	.6	10,267	2.5	31,779	3.6	42,051	2.42
Alaska	2,549	.6	67,808	16.6	125,619	14.3	195,976	11.42
TOTALS	433,060	100.0	408,704	100.0	874,020	100.0	1,715,784	100.00

*SOURCE: Larsen, Spencer A.; Reitz, William; Burgum, Katherine K.; *Markets for Airborne Seafoods*, (1948), Wayne University Press, Detroit. p. 66.

If, then, there exists (1) an air carrier who is interested in seafood traffic and (2) quantity production of seafoods having a high propensity to air carriage, the next problem is their preparation and packaging for shipment.

Packaging Airborne Seafoods

Airfreight calls for drastic changes in the methods of packaging seafoods. Generally it is advisable to eliminate dispensable weight, such as viscera, heads, ice, and heavy wooden containers.

Fish now are transported by surface means in cumbersome wooden boxes and barrels of varied shapes, dimensions, and weights. These containers range in size from 50 to 200 pound capacity, a 100 pound capacity box being quite generally used. This size of container was used as the unit of comparison in the cost study.

A wooden container which holds 100 pounds of fish weighs 27 pounds itself and calls for about 50 pounds of ice, being re-iced when necessary. The shipping of 100 pounds of fish in the conventional manner requires, then,

TABLE 2
AVERAGE 1939-1941 CATCH OF FRESH FISH AND SHELLFISH
FOR THE SOUTH ATLANTIC AND GULF AREAS BY AIR PROPENSITY CLASSES *
(IN THOUSANDS OF POUNDS)

EXCELLENT		GOOD		FAIR	
SPECIES	POUNDS	SPECIES	POUNDS	SPECIES	POUNDS
Lemon Sole	79	Bluefish	3,314	Croaker	4,849
Pompano	685	Blue Runner	746	Scup	76
Shad	1,287	Butterfish	56	Buffalofish ¹	60
Snapper, Red	7,212	Drum: Black	1,266	Carp ¹	366
Striped Bass	440	Red	2,258		
Clams: Hard	1,342	Flounders:			
Crabs: Hard	29,513	Blackback	249		
Soft and Peelers	468	Fluke	157		
Lobsters: Spiny	411	Gray Sole	145		
Oysters: Eastern	24,332	Yellowtail and			
Scallops: Bay	158	Dabs	682		
Shrimp	149,306	Grouper	6,024		
		Kingfish or King			
		Mackerel	3,746		
		Mullet	36,923		
		Sea Trout: Gray	3,237		
		Spotted	6,827		
		Sheepshead	966		
		Spanish Mackerel	6,908		
		Spot	5,176		
		Catfish and			
		Bullheads ¹	5,533		
Totals	215,233		84,213		5,351

1 Fresh water fish

*SOURCE: Larsen, Spencer A.; Reitz, William; Burgum, Katherine K., *Markets for Airborne Seafoods*, (1948), Wayne University Press, Detroit. p. 64.

about 77 pounds of container and ice or a minimum of 70 per cent of the net weight of the fish.

Wooden containers are purchased at an average cost of 1¼c for each pound of seafood capacity; a box designed to carry 100 pounds of seafood costs in the neighborhood of \$1.25.

Obviously this conventional fish pack is unsuited for air shipments, and indeed it is doubtful if it is the best method for shipment by relatively rapid means of surface transportation. Conventional methods of packing fish are found wanting in air shipments because:

- (1) There is too much useless weight.
- (2) Water from melting ice damages other cargo.
- (3) Melting ice and open containers result in objectionable fish odors and corrosive damage to planes and other vehicles.

In an effort to develop a new principle for the shipment of fresh seafoods air cargo research at Wayne University enlisted the aid of the Goodyear Tire

and Rubber Company and the Hinde and Dauch Paper Company. After a great many trials of various methods of preparing seafood for air shipment, a light-weight corrugated container was developed. This light-weight container is moisture proofed with a Pliofilm envelope and insulated with Plycraft. The box holds about 45 pounds of seafood which, before packing, is precooled to 32 degrees F. This box weighs 4½ pounds or 10 per cent of its net load. Packed for shipment, the temperature rise in this package ranges from .5 of a degree F. to 1 degree F. per hour when the outside temperature is between 60 degrees and 90 degrees F.

When packed with seafood, the Pliofilm envelope is sealed so as to prevent moisture from getting to the container thereby lessening its strength and insulating efficiency. Both the inner and outer containers are closed securely with strips of tape.

Comparison of Costs

A comparison of the total costs of shipping 100 pounds of fresh fish via scheduled air carriers from different points of origin to Detroit is presented in Table 3. Both air and surface hauls include pick-up and delivery. The shipping costs include the expenses of packaging materials for which the conven-

TABLE 3
COMPARATIVE COSTS OF SHIPPING SEAFOODS BY RAIL EXPRESS
AND AIRFREIGHT FROM REPRESENTATIVE CITIES TO DETROIT—(Nov. 1949)

ORIGIN	<i>Cost of Transportation, Ice (for Rail Express only) and Box Per 100 Pounds of Net Weight of Fish</i>	
	RAIL EXPRESS*	AIRFREIGHT*
New York	\$5.00	\$6.00
Boston	5.91	6.01
Norfolk	6.07	6.40
Jacksonville	9.01	10.35
New Orleans	9.01	11.30

**Both services include pick-up and delivery.*

tional wooden box and ice runs to \$1.25 per 100 pounds of net fish and for the iceless insulated pack \$1.50 per 100 pounds or an additional packaging cost of 25 cents per 100 pounds for air shipment.

In the cost comparison a shipment unit of 177 pounds is used for rail express which consists of 100 pounds of fish, 50 pounds of ice and 27 pounds of box weight.

A unit of 100 pounds is used for airfreight which consists of 91 pounds of fish and 9 pounds of container.

Cost comparisons for shipping facilities and transportation from several points of origin to Detroit show some, but relatively small, variation depending upon the points of origin and the type of air carrier employed. As already stated, the total costs of shipping fresh water fish from the Great Lakes to New York are reported to be the same for airfreight and for rail express when transported by a contract air carrier.

Generally, as will be seen in Table 3, the adjusted costs of shipping fresh fish from Boston, Norfolk, Jacksonville, and New Orleans, to Detroit via airfreight are only slightly higher than for rail express. As recent as four years ago costs of shipping by air were more than five times what they are today.

A dealer who is considering shipping seafoods via airfreight should remem-

ber that the methods and standards of such an operation are vastly different. Useless weight must be eliminated, the temperatures of the product kept in the thirties, and time saved.

A step by step guide for the packaging and marketing of airborne seafoods together with detailed information on production, consumption, costs and propensity to air carriage appears in the study "Markets for Airborne Seafoods." Developments in the industry since publication of this study indicate, however, that a realistic research job has been done. It is believed to be a blueprint that will work if sensible adaptations are made in it.

An Economic Survey of the Texas Fishing Industry

A. W. ANDERSON

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THE TEXAS GAME, FISH AND OYSTER COMMISSION MARINE LABORATORY made an attempt to survey the dollar value of the Texas fishing industry. Little was known of the economic condition of the fishing industry along the Texas coast because Stevenson's work (1863) is, of course, outdated. The expansion of the frozen food industry has made the work of Woolrich (1946) inaccurate for general use. The work of Woolrich and Stevenson was and is of great value but with the change of the economic standards after World War II there was a need for a re-valuation of the Texas fishing industry.

McDaniel (1949) estimated that the commercial seafood industry had an investment in Texas amounting to \$40,325,000.00. This estimate considered not only the investment along the coast but also the investment of many inland retailers, wholesalers and freezing plants dealing with marine products. The survey by the Marine Laboratory did not include these inland investments nor did it include seafood cafes inland or on the coast. McDaniel's estimate of the value of 2,220 fishing boats is only \$4,400,000.00, which is very conservative. The number of fishermen on fishing boats is higher than reported in this survey but probably includes many of the part-time fishermen in skiffs.

Under the direction of Mr. J. L. Baughman, Chief Marine Biologist, Texas Game, Fish and Oyster Commission, Mr. Byron B. Baker, Jr., Mr. F. M. Daugherty, Jr. and the author contacted the owners of the various commercial fish houses, boats, shipyards and freezing plants. A standard questionnaire form was used to record the information given us. Each owner was assured that the information would be used to compile totals for each area and that the information would not be used singularly for any one house, boat, shipyard or freezing plant. In many cases the information was taken from the company books. All information is based on the calendar year 1948.

The extent of the fishing industry made it impossible to cover every detail and the values expressed represent only the basic value of the industry. In the expressed totals the figures were rounded off to the nearest one hundred or one thousand dollars depending on the figure in question.

The figures in Tables 1 and 2 represent only the major items considered. Many minor items are not included.

Commercial Fish Houses

In 1948 there were 83 commercial fish houses on the Texas coast with a total investment valuation of \$2,583,000.00. The payroll for the permanent em

TABLE 1
VALUATION AND EXPENSES OF THE TEXAS GULF COAST FISHING INDUSTRY

FISH HOUSES	
<i>Houses</i>	
Number	83
Valuation	\$2,583,000.00
<i>Permanent Employees</i>	
Number	319
Payroll	\$748,000.00
<i>Part Time Employees</i>	
Payroll	\$429,000.00
<i>House Owned Trucks</i>	
Number	151
Valuation	\$329,000.00
Expense	\$166,000.00
FISHING BOATS	
Number	1,393
Valuation	\$7,383,000.00
<i>Expense</i>	
Maintenance	\$1,180,400.00
Fuel	\$1,199,600.00
Ice	\$ 855,000.00
FREEZING AND COLD STORAGE	
<i>Capacity in pounds of Marine Products</i>	
Freezing 24 hrs.	528,200
Storage above 32° F.	712,000
Storage below 32° F.	2,473,300
SHIPYARDS	
Number	21
Valuation	\$1,623,000.00
Payroll	\$ 575,000.00
CHARTER BOATS	
Number	114
Valuation	\$415,000.00
Maintenance	\$ 80,000.00
Fuel	\$ 67,000.00

TABLE 2
VALUATION AND EXPENSES OF THE TEXAS GULF COAST FISHING INDUSTRY

AREA	CAPITAL INVESTMENT	VALUATION	EXPENSE
1. Port Isabel	\$ 1,111,000		\$ 347,000
2. Corpus Christi	986,000		740,000
3. Port Aransas	200,000		93,400
4. Aransas Pass	1,313,000		441,000
5. Rockport	1,311,000		454,000
6. Port Lavaca	683,000		1,025,000
7. Palacios	1,116,000		379,000
8. Matagorda	92,000		49,000
9. Freeport	444,000		172,000
10. Houston	378,000		171,000
11. Galveston Bay	899,000		198,000
12. Galveston	1,665,000		963,000
13. Port Arthur	2,135,000		997,000
TOTAL	\$12,333,000		\$6,029,400

ployees in these 83 houses exceeded \$748,000.00. There were 319 permanent employees concerned. The payroll for the part-time employees exceeded \$429,000.00. It was impossible to determine the number of part-time employees.

There were 151 house-owned trucks with a total value of \$329,000. The truck operating expense exceeded \$166,000.00 in 1948. Generally, shipments of marine products are F.O.B. the point of origin, and charges are paid by the receiving company.

The type of construction and floor space of the houses was considered but is too general to be shown here.

Fishermen

In 1948 there were 2,557 commercial fishermen on the Texas coast as compared to the 601 reported by the U.S. Fish Commission in 1880. Stevenson reported that there were 1,277 commercial fishermen in 1890. He reported a property value of only \$315,000. This property value of \$315,000 was based on the value of the sail craft, skiffs, apparatus of capture, shore property and cash capital.

In 1948 the fishermen received \$6,500,000 for their catch. This estimated value is based on the production figures and average price in 1948. It should be noted that this estimated figure is above the total expense of the fishing industry.

Fishing Boats

There were 1,393 commercial fishing boats in use in 1948. Their value exceeded \$7,383,000. The maintenance costs on these boats was slightly over \$1,180,000 which included haul-outs and mechanical work. The fuel costs for 125 diesel boats and 1,221 gasoline powered boats was \$1,199,600. There were 47 sail boats fishing on the Texas coast. The annual ice cost was \$855,000 while gear maintenance cost was \$729,400. The total expense of the fishing boats was \$3,964,000 in 1948.

Twenty-four of the fishing boats had depth recorders. The number of fishing boats with depth recorders is increasing. Two hundred and fifty-two boats were equipped with radio receivers while 168 other boats had two-way radios.

The fishing days per boat ranged from 60 to 220. The average number of working days per year was 140.

Freezing and Cold Storage

Woolrich listed several freezing plants with a freezing capacity of 500,000 pounds for each twenty-four hour period. This economic survey of the Gulf Coast considered all but one of the freezing plants listed by Woolrich. Comparable figures would show a freezing capacity of 600,000 pounds each twenty-four hour period in 1948.

The storage capacity for marine products below 32° F. totaled 2,473,300 pounds in 1948. The same type storage capacity in 1946 was only slightly over one million pounds.

The storage capacity for marine products above 32° F. in 1948 was 712,000 pounds.

Ship Yards

Boat maintenance is an important item to the boat owners of the Texas coast. There were twenty-one boat yards in Texas doing work on fishing boats. Fishing boat maintenance, that year, amounted to over \$1,180,000. The twenty-one boat yards had a total of 296 permanent employees. The payroll for these employees was \$575,000.

Charter Boats

At first glance, the charter boat service to the sports fishermen along the Texas coast appears to be of great importance. When one drives along the docks at Corpus Christi, Port Aransas or Port Isabel, Texas, it appears that there is a great amount of money invested in the charter boat service. Survey figures do not show this to be true.

The Port Aransas area has a total of \$188,000 invested in the charter boat service. Their annual maintenance cost is \$35,000, while the annual fuel cost

is \$40,000. With a capital investment of \$70,000, Corpus Christi ranks second in charter boat service. Their annual maintenance cost was set at \$5,000. The annual fuel cost was estimated at \$3,000.

Port Isabel has a capital investment of \$40,000. The annual maintenance and fuel costs are not known.

The total value of 114 charter boats on the Texas coast was set at \$415,000. The maintenance cost was \$80,000 and the fuel cost for the same period was \$67,000.

Grand Totals

The valuation and expenses of the Texas Gulf coast fishing industry are shown by items in Table 1. The number and valuation of the commercial fish houses is shown on Table 1. The permanent and part-time employee payroll for the fish houses was in excess of one million dollars. The house owned trucks were valued at \$329,000 and their maintenance cost was \$166,000 in 1948. The number of commercial fishing boats was 1,393 with a total valuation of \$7,383,000. The total expense of these boats was \$3,964,400 during the above mentioned period.

Table 1 also shows the freezing and cold storage capacity of the freezing plants. It shows the total number and valuation of the ship yards and also the number and valuation of the charter boats with their maintenance and fuel costs.

Table 2 shows the valuation and expenses of the Texas fishing industry by area. The Port Aransas, Galveston, Rockport, Aransas Pass, Palacios and Port Isabel areas have the greatest capital investment. In all probability they are the greatest producers of marine products on the Texas coast. There is no basis for a comparison of the valuations and expenses as shown in Table 2.

Summary

The work of Stevenson (1893) gives us a good means of comparison of the increased capital investment and expenses. In 1948 there was \$12,333,000 invested in the fishing industry of the Texas coast. Stevenson reported \$315,427 in 1890 or about 39 per cent of today's investment.

Woolrich (1946) reported that there was a freezing capacity of about 500,000 pounds of marine products in the various freezing plants on the Texas coast. In 1948 this capacity had increased to 600,000 pounds.

The capital investment valuations in this report are not as high as those shown by McDaniel (1949). This report does not consider the many types of businesses that lie inland and deal with marine products.

Texas is growing! This important production of our natural resources is linked directly with the sorely needed increased production of industrial products. The increased production of our natural resources in the past thirty years has made it necessary to impose upon the producers various types of management regulations.

Farm products have felt the restriction and aid of the federal government. The oil industry in Texas has seen the restriction of oil production as a conservation measure. Likewise, the producers of marine products have had restrictions imposed upon them to stop needless waste.

Today the production of these products is above the production of yesteryear, and rightly so. The increased need by the people of the world has forced production up and up. The restrictions, we hope, have not retarded the needed production but have limited and decreased the waste above and beyond the production that could be utilized.

As time goes on each industry looks for new fields into which it can expand. The fishing industry is no exception. Since 1946 the red shrimp production has aided the fishermen of the Texas coast. In 1948 mullet fishery was opened on a small scale. There is now a possibility of a shark fishery on the Texas coast. These new products call for a higher capital investment and higher expenses and at the same time benefit the fishing industry to the people of Texas.

The people of the nation and the world benefit from the added investment and expenses. This money goes to various places to produce the needed equipment and materials for the increased production.

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The Legislative Situation on Sponges

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1. General Background of the Present Condition of the Sponge Market

BEFORE REFERRING to the legislative situation on sponges, the general background of the present condition of the American and Caribbean sponge market must be discussed.

The principal commercial sponges are sheepswool, yellow, velvet, grass, wire, reef, and hardhead, largely from the waters of the United States, Cuba, and the Bahamas; and Turkey cup, Turkey toilet, Zimocca, elephant-ear and honeycomb or Mandruke, chiefly from the Mediterranean countries. The Turkey cup, Turkey toilet, and minor species of similar texture are marketed in the United States as Mediterranean silk sponges. The West Indian reef sponges are finer grades of hardhead from the same source are marketed as American silk sponges.

The best grades of American sponges are obtained by divers who descend in diving suits to depths of 100 feet or more. Sponges in shallower waters are gathered from boats by pronged hooks on the ends of long poles. The use of drag nets does a great deal of harm to the sponge beds because it uproots small sponges as well as those of marketable size, and is therefore not permitted in the Florida sponge fishery.

2. American Production of Sponges

There were employed about 730 sponge fishermen in 1940 and 1123 in 1939. Many in the meantime migrated to other employment. Where formerly 200 boats were employed there are now 60.

The production of sponges in the United States is confined to a limited area along the West Coast of Florida, and yielded a production of 158,304 pounds in 1947, at \$1,741,883, or \$11 per pound. Among the 1947 production were 12,456 lbs. large wool; 15,715 lbs. small wool; 99,408 lbs. wool rags; 127,579 lbs. total wool; 11,220 lbs. yellow and 19,505 lbs. grass sponges. Fluctuations in the annual catch, at least until the middle '30's, were caused mainly by

weather conditions, for about the same number of vessels were employed in the fishery from year to year. As can be seen from Table 1, U.S. sponge production decreased from an average of 628,489 lbs. for six years, 1934 - 1939 inclusive to a low of 134,581 lbs. in 1948.

TABLE 1
TOTAL UNITED STATES SPONGE PRODUCTION (1934-1944)

YEAR		TOTAL POUNDS	TOTAL VALUE	AVERAGE UNIT PRICE PER POUND
1934		655,000	837,000	1.28
1935		655,000	838,000	1.28
1936	AVERAGE	739,939	1,105,000	1.49
1937	628,489	631,000	1,220,000	1.93
1938		606,000	1,071,000	1.77
1939		484,000	1,162,000	2.40
1940		243,000	888,000	3.65
1941		231,179	1,483,554	6.42
1942		211,816	1,848,095	8.72
1943		200,161	2,505,521	12.52
1944		164,724	2,771,590	16.82
1945		203,447	2,716,374	13.35
1946		156,916	2,945,831	18.77
1947		158,304	1,741,883	11.00
1948		134,581	899,927	6.69

1. Total United States production figures for these years are not available. Sales of sponges on the Tarpon Springs Exchange in Florida are available, and an estimate of the total production was made by using an average ratio of total production to sales on the Exchange and projecting it to the four years.

3. Cuban and Bahamian Production of Sponges

The production of Cuba shows an even sharper decrease, as may be seen from Table 2.

TABLE 2
CUBAN SPONGE PRODUCTION 1935-1948

YEAR		QUANTITY	VALUE	AVERAGE VALUE PER POUND
1935-1939	av.	652,000	378,000	0.58
1940-1944	av.	95,250	450,800	4.73
1945		27,050	214,810	7.94
1946		44,070	442,500	10.04
1947		16,230	132,090	8.14
1948		18,000	124,000	7.00

The production in the Bahamas similarly declined from a high of 1,486,000 lbs. in 1905 to about 32,500 lbs. in 1948.

The decline of production was due in large part to the destruction of sponge beds by hurricanes of about half of the supply in the Bahamian waters and the depletion by excessive fishing of Cuban beds. Some measure of recovery was noted after 1933, but in 1939 a blight attacked the Bahamian and Cuban beds in addition to those in Florida. The velvet sponges in the Bahamas were almost completely destroyed, and after 1939 the Bahama Islands ceased to rank as the principal competing country for this product. So far there are no signs of recovery.

4. Imports of Sponges

Before World War II approximately 1 million pounds of sponges were consumed in the United States. Imports supplied about one half of the total con-

sumption. From Table 3 the total imports of sponges in the United States may be seen, while Table 4 contains the imports from Cuba, the British West Indies and the "Other Countries."

TABLE 3
TOTAL UNITED STATES IMPORTS OF ALL SPONGES (1934-1944)

YEAR		TOTAL POUNDS	TOTAL VALUE	AVERAGE UNIT PRICE PER POUND
1934		479,307	\$ 387,730	\$0.81
1935		613,143	464,211	0.76
1936	Average 523,373	605,683	561,738	0.93
1937		581,906	587,620	1.01
1938		428,664	475,238	1.11
1939		431,536	476,035	0.97
1940		519,041	588,763	1.13
1941		222,117	518,107	2.33
1942		117,528	613,010	5.22
1943		194,781	909,205	4.67
1944		123,581	944,459	7.64
1945		95,596	791,979	8.28
1946		328,281	3,087,321	9.40
1947		208,653	1,674,818	8.03
1948		355,015	2,587,305	7.29
1949 Jan.-July		187,639	1,390,603	7.41

SOURCE: *Foreign Commerce and Navigation of the United States—1934-1944.*

TABLE 4
TOTAL UNITED STATES IMPORTS FROM CUBA AND THE BRITISH WEST INDIES

	CUBA		BRITISH WEST INDIES		OTHER COUNTRIES	
YEAR	TOTAL POUNDS	IMPORTS VALUE	(BAHAMAS) POUNDS	IMPORTS VALUE	TOTAL POUNDS	IMPORTS VALUE
1934	Average 322,810	309,502	Average 678,682	134,779	Average 33,397	69,053
1935		389,167		192,306		85,271
1936		363,680		189,973		77,626
1937		315,922		227,056		90,290
1938		271,466		141,195		62,816
1939		277,124		187,783		68,688
1940		464,589		38,998		44,731
1941		185,636		21,662		55,767
1942		101,317		17,562		25,828
1943		191,636		572		102,552
1944		118,076		14,652		30,178
1945		62,898		87		277,796
1946		70,234		400		2,478,767
1947		32,098		75,843		1,337,627
1948		46,505		8,970		2,342,394
1949-Jan.-July		20,456		7,852		1,275,821

Before the war Cuba supplied roughly 66 per cent of the quantity of all imports of sponges in the United States, and the British West Indies almost 33 per cent. The other countries, among which the Mediterranean countries, especially Greece and Italy, have to be mentioned, supplied the rest, about 1/19 of all imports. After the war the import situation changed completely. Sponge fishing in the Mediterranean, which was interrupted during the war, was resumed and expanded. Because of the short supplies available from domestic sources and the short supplies available in Cuba and the British West Indies, imports from the Mediterranean area increased tremendously. In 1948 Cuba exported only about 13 per cent of all our imports, the British West Indies about 0.2 per cent, while the Mediterranean countries participated with about 87 per cent of the imports. The relationship of imports to domestic production

developed inversely. While in 1938 imports equalled about 75 per cent of the domestic production, in 1948 they surpassed domestic production by about 160.5 per cent.

5. *Sponge Tariffs and Tariff Policies*

To protect the growing American sponge industry, a tariff was established which applied to all countries except Cuba, which has a 20 per cent preferential tariff on all products. The Tariff Act of 1913 (par. 68) provided rates of duty at 10 or 15 per cent ad valorem on all types of sponges imported. Sponges, trimmed or untrimmed, but not further advanced in value by chemical processes, were dutiable at 10 per cent ad valorem; bleached sponges and sponges advanced in value by processes involving chemical operation, 15 per cent. In the Tariff Act of 1922 (par. 1447) a rate of 15 per cent ad valorem was set on all types of sponges and 25 per cent on manufacture of sponges.

The Tariff Act of 1930 (par. 1545) provides: "Sponges, commercially known as sheepswool, 30 per centum ad valorem; sponges, commercially known as yellow, grass, or velvet, 25 per centum ad valorem; all other sponges, not specially provided for, 15 per centum ad valorem; manufacture of sponges, or of which sponge is the component material of chief value, not specially provided for, 25 per centum ad valorem." Under a decision of the Customs Court (Abs. No. 21073) July 28, 1932, sponge clippings were held to be entitled to free duty under paragraph 1750 of the Tariff Act of 1930, as paper stock rather than dutiable at 10 per cent as waste.

By Presidential Proclamation, effective September 18, 1932, under Section 336 of the Tariff Act of 1930, the duty on sheepswool sponges was reduced to 22½ per cent.

In September 1934, a trade agreement between the United States and Cuba provided for a reduction in the rate of duty on velvet sponges from 20 per cent (the preferential rate for Cuba) to 12 per cent, and the rate of duty on sponges not specially provided for was reduced from 12 per cent (the preferential rate for Cuba) to 6 per cent. The latter included hardhead, reef, and all others.

In a trade agreement with the United Kingdom (including the Bahamas), effective January 1, 1939, rates of duty on yellow, grass, and velvet sponges were reduced from 25 per cent to 15 per cent and on hardhead and reef, from 15 per cent to 7½ per cent.

6. *Protection of Sponges Under Biological Control*

At present commercial sponge resources of the United States are protected both by an Act of the Congress of the United States and by the laws of the State of Florida. The Act of Congress (Public No. 172, approved August 15, 1914; 38 Stat. 6921) prohibits the capture in waters of the Gulf of Mexico and the Straits of Florida, outside of the limits of territorial jurisdiction, of sponges measuring less than five inches in diameter when wet. This Act also forbids the landing, curing, possession, or sale of sponges less than that size and provides penalties for violation. The laws of Florida (Chapter K, Art. 27, Sec. 8084) contain substantially the same prohibitions with respect to catching and marketing sponges within the territorial limits of the State. A State law also provides that hooks used in removing sponges from the bottom shall be five inches wide and prohibits the use of diving equipment for taking sponges within the territorial limits of the State. In accordance with the Constitution of Florida, State jurisdiction on the West Coast extends three leagues (nine miles) from shore.

An Executive Order was issued by the President of the United States on September 28, 1945, regarding boundaries of territorial jurisdiction of the United States. It is a statement of policy; how far the present jurisdiction has been changed or extended is not yet known.

7. Unit Values of Sponges and Fishermen's Incomes

The unit values of both domestically harvested sponges and imported sponges rose extremely during the war. While in 1938 the unit value of domestic sponges per pound was \$1.80, this unit value in 1946 was \$18.77, receding in 1947 to \$11.00, in 1948 to \$6.69 and in 1949, according to estimates for the first seven months, to \$6.09. The unit value of imported sponges never reached the height of the domestic sponges. In 1938 it was \$1.11, in 1946, \$9.02, receding in 1947 to \$8.03, and in 1948 to \$7.28. In the first seven months of 1949 the unit value for imported sponges was \$7.41 per pound. From Tables 5 and 6 it can be seen that imported sponges retain a higher sales value than domestic

TABLE 5
UNIT VALUE PER LB. OF SPONGES PRODUCED IN U.S. 1931—JULY, 1949

YEAR	UNIT VALUE (PER POUND)
1931	\$ 1.58
1933	1.13
1935	1.60
1937	1.95
1938	1.80
1939	2.44
1943	10.61
1946	18.77
1947	11.00
1948	6.69
1949 (7 months)	6.09

SOURCE: Official statistics of the U. S. Fish and Wildlife Service

TABLE 6
UNIT VALUE PER LB. OF SPONGES IMPORTED IN U.S. FOR CONSUMPTION
1931—JULY, 1949

YEAR	UNIT VALUE (PER POUND)
1931	\$1.16
1933	.88
1935	.76
1937	1.01
1938	1.11
1939	.97
1943	4.65
1945	8.28
1946	9.40
1947	8.03
1948	7.29
1949 (7 months)	7.41

SOURCE: Official statistics of the U. S. Department of Commerce.

sponges, not only absolutely but also in relationship to pre-war years. However, it has to be considered that the price of domestic sponges is a price paid at the Tarpon Springs exchange, to which packing and shipping costs have to be added, while the price of imported sponges already include packing and shipping costs.

8. Pending Legislation

Pending legislation attempts to go in two directions. First, efforts are being made to increase production by replenishing the sponge beds, after further in-

investigation of the causes of their depletion. Secondly, efforts are being made to secure higher prices, and by that a higher income for the sponge fishermen. Higher prices are attempted by either restricting imports or by levying higher duties upon imports.

To evaluate the importance of the regress of domestic production and the recession of prices, one has to look on the over-all income of sponge fishermen resulting from their production. If one considers the total value of the United States sponge production and assumes that this total value is about equal to the sponge fishermen's income, one can see that the 1948 income was about the same as the 1940 income. If one assumes that the number of sponge fishermen has not noticeably changed, the conclusion is permitted that the income of each individual fisherman is today about the same as it was in 1940: \$1200 - \$2000 per year, despite the cost of living increase of about 69 per cent and food cost of about 104 per cent. Under these circumstances there is no wonder that the sponge fishermen attempt to move the legislative forces in their favor.

Before speaking of individual bills which specifically deal with sponges, it is necessary to call attention to a bill which is of general importance, namely, Senate Bill 1965, introduced by Senator Malone, which would apply to sponges, among other important products. Senator Malone would like to see established a *Foreign Trade Authority* with the following duties:

"(a) The Authority is authorized and directed, from time to time, and subject to the limitations hereinafter provided, to prescribe and establish import duties which will, within equitable limits, provide for fair and reasonable competition between domestic articles and like or similar foreign articles in the principal market or markets of the United States. A foreign article shall be considered as providing fair and reasonable competition to United States producers of a like or similar article if the Authority finds as a fact that the landed duty paid price of the foreign article in the principal market or markets in the United States is a fair price, including a reasonable profit to the importers, and is not substantially below the price, including a reasonable profit for the domestic producers, at which the like or similar domestic articles can be offered to consumers of the same class by the domestic industry in the principal market or markets in the United States."

Specific bills dealing with the sponge industry are S. 2097 and S. 5322. S. 2097 would provide "that the Secretary of Agriculture, through the Commodity Credit Corporation and other means available to him for supporting prices of agricultural commodities (treating natural sponges as an agricultural commodity for the purposes of this Act), shall support the price of natural sponges to producers at such levels as may be necessary to preserve the continued operation of the domestic natural sponge industry." The bill H.R. 5322 (Mr. Peterson) is identical to S. 2097. A specific investigation by the United States Tariff Commission concerning sponges is sought by S. Res. 109 which would provide "that the United States Tariff Commission is directed under authority conferred by section 336 of the Tariff Act of 1930, and for the purposes of that section to investigate the differences in the costs of production of the following domestic articles and of any like or similar foreign articles: Sponges."

On August 25, 1949 Senator Pepper introduced a bill (S. 2489) which has the following text: "That there is hereby authorized to be appropriated the sum of \$250,000, to enable the Secretary of the Interior in cooperation with such States as may desire to participate, (1) to carry out a program of research and experiment with respect to natural sponges, (2) to propagate and plant

natural sponges, (3) to study diseases of natural sponges, and (4) to take other appropriate action to assist in the further development of the natural-sponge industry. Any sum appropriated under the authority of this Act shall remain available to the Secretary of the Interior until expended. (H.R. 6063 (Peterson) is identical.) On the same date a bill, S. 2490, was introduced by Senator Pepper (H.R. 6064 (Peterson) identical), which would direct "That the Director of the National Bureau of Standards shall make a study of the relative merits (as to durability and other pertinent characteristics) of natural sponges and synthetic sponges with respect to the various purposes for which sponges are commonly used, and shall, as soon as practicable, report the results of such study to the President of the Senate, the Speaker of the House of Representatives, the Secretary of Defense, the Secretary of the Interior, the Secretary of Commerce, and to the heads of such other Government agencies using sponges as he considers appropriate." This latter bill deals specifically with the relative merits of natural and synthetic sponges.

That the competition of *synthetic* sponges is not negligible, may be seen from the tremendous inroads made by the synthetic sponges. 1948 figures of sponge purchases of public agencies or public institutions have been obtained.:

1. Bureau of Federal Supply—It did not buy rubber or plastic sponges. It bought \$20,000 worth of natural sponges at an average price of 90c a piece (precisely 21,446 pieces at \$20,945) and it bought 33,000 cellulose sponges at an average price of 38c a piece (precisely, a total purchase price of \$12,683).

2. Post Office Department—It bought no natural or rubber sponges. It bought 55,000 cellulose sponges at the price of \$6,720; this means an average price of 12c a piece.

3. The Army Ordnance Department—It brought no natural sponges or rubber sponges. It bought 10,000 cellulose sponges, size E at 40c a piece, equal to \$4,000. It further bought 75,000 cellulose sponges, sizes 10, for the total price of \$27,800, at an average price of 37c a piece, and another 150,000 cellulose sponges, size 6, for the price of \$21,000 (about 14c a piece).

4. Navy Stores—It bought 23,000 natural sponges at the price of \$16,000 (average price 70c a piece); it also bought 6,000 cellulose sponges for \$2,500 (average price of 42c a piece).

Despite the strong competition of the synthetic sponge there is still a great demand for natural sponges, according to private investigations. Drug store owners and drug store managers indicate that they can sell at present the double quantity of natural sponges if the price could be reduced by about 50 per cent.

Concluding, the problems of the American, Cuban and Bahamian sponge industries may be stated:

- (1) Diseases and probably overfishing decreased sponge supplies available. For the improvement of the economic condition of the fishermen, at least double the present supplies have to be harvested.

- (2) Natural sponges must be made available in the retail markets with prices which are in a proper relationship to the general cost of living, and to the cost of other products.

- (3) Public purchasers should consider more than has been done in recent years the producers of natural sponges.

- (4) If the tariff policy of the United States is to be revised, proper consideration should be given to the producers of natural sponges, to permit them fair costs of production and a reasonable profit.

The Social and Economic Problems of The Florida Commercial Fisherman

ARTHUR H. TODD, *Secretary-Treasurer, Florida Brotherhood of Fishermen*

THE INTEREST of the Florida Brotherhood of Fishermen is centered on the commercial fisherman and in improving his economic condition. In order to accomplish this purpose it is essential to have a complete and comprehensive scientific survey of our salt water resources. Conservation laws must be revised and ample funds must be provided to carry on continuous scientific research and to assure enforcement of the laws and rulings laid down. Salt water conservation is used as a political football and it is imperative that this situation be changed in one way or another. The social ills from which the fisherman suffer can be cured by an improvement in his economic condition. At the present time probably less than 20 per cent can read and write. This condition exists mainly because he had to start fishing to help provide a bare existence for the family when he should have been in school. The situation is improving through the Public School system of transportation, and insistence on school attendance. Many thousands of our commercial fishermen live in homes that are no more than shacks, and without enough chairs to seat the entire family at one time. Many are without screens and do not have any of the modern conveniences that even our day laborers have. Ninety five per cent are continuously in debt to fish dealers and are kept in a virtual state of peonage as a result of this indebtedness. Although the commercial fisherman is theoretically an independent producer he cannot be independent with a club over his head.

The causes of this condition may be considered under six headings.

First of all is the low level of fish production. For over two years production has been low. During the Red Tide on the west coast very few fish were landed. Appeals were made to the Senators and Congressmen but only wires and letters were received stating that no funds were available for direct relief. A plan to set up stations of some kind along the coast to give temporary employment to the fishermen was suggested, but nothing was done. Since the scourge of the Red Tide, production has not returned to its previous level and unless some sensible conservation is put into effect, it probably will not do so.

Unfair competition is a second cause. Tens of thousands of people come to Florida every year ostensibly for sport fishing. The fact is, however, that they fish as a business and sell their catches commercially. Thousands of Florida residents, who earn a good living in various other trades and professions, turn to commercial fishing during the run season. This helps to create a glut on the market and to lower prices for the year-round commercial fisherman.

Third are the many harmful and destructive methods used by both commercial and sport fishermen.

Fourth is the lack of enforcement of conservation laws. Everyone in the fishing industry knows how little enforcement there is of existing conservation laws. Untold thousands of pounds of under-legal-size trout alone are caught and sold each year by both commercial and so-called sport fishermen. Last year during the closed season on mullet it was common knowledge that several hundred thousand pounds of mullet were netted, transported out of Florida and sold.

Fifth is the opposition of some factions to any change being made in the methods of applying conservation to the salt water fisheries. It is very apparent that they want salt water conservation to remain in the same chaotic condition that has prevailed for many years.

Sixth is unjust taxation. For years the commercial fisherman has been paying a road tax of six cents per gallon on gas used strictly in vessels engaged in commercial fishing. This tax alone amounts to several hundred dollars per year to many of our fishermen. Governor Fuller Warren recognized the unfairness of this tax and asked the legislature to relieve the fishermen of this burden. However, a bill to relieve the fishermen of this tax was killed in committee.

The Florida Brotherhood of Fishermen has attempted to relieve this situation, but it failed in accomplishing anything at the last meeting of the State Legislature. Almost two years were spent holding meetings and interviewing commercial fishermen throughout the tidal waters of Florida, and finally a program was worked out which was approved by twenty-two branches of our organization.

Here is the original program:

1. That all local and special fishing laws be repealed at once.
2. That legislation be enacted to give full power over salt water conservation to the present Conservation Board, with a provision that a complete factual scientific survey of all salt water resources be made as speedily as possible and that the Board be governed by the findings of this survey in making future rules and regulations governing our salt water resources.
3. That, for the protection of our commercial fishermen and to provide sufficient funds to finance the continuation of research, the following license fees be imposed: Resident commercial fishermen, \$25.00 per year; out of State and alien commercial fishermen, \$100.00 per year.
4. That it should be made unlawful for any persons except licensed commercial fishermen to sell their catch.
5. That a small license fee and a bag limit be imposed on sport fishermen.
6. That the commercial fishermen be exempt from payment of the six cent road tax on gasoline used in commercial fishing craft.

We attempted to work out a joint program with the commercial fish dealers. A meeting of commercial fishermen's representatives and fish dealers was held on December 18, 1948 and the following program was agreed upon:

(1) That the mullet fishery research program started by the University of Miami Marine Laboratory in October, 1948 be continued, and expanded to include all species of salt water fish and seafood produced in Florida waters, this to be a permanent program. (2) That priority be exercised to determine if some methods of taking fish such as stop netting, seining, and with small mesh nets are harmful to the fishery. (3) That all local and special fishing laws be repealed and the basic fishing laws be revised under the supervision of the scientists. (4). In order to provide ample funds for the research program, that all commercial fishermen be licensed as follows: Resident commercial fishermen, \$5.00 per year; out of State and alien commercial fishermen, \$25.00 per year. The above license fees were to be used exclusively to finance the research program. (5) That it be made unlawful for any person or persons other than regular licensed commercial fishermen to sell their catch.

The matter of license and bag limits on sport fishing was left to the discretion of the Executive Committee, the general opinion being that a small license fee be charged and a reasonable bag limit should be imposed. It was agreed that the gasoline road tax as applied to commercial fishing craft is unjust and that every effort be made to have this tax removed at the earliest possible date.

The following Executive Committee was elected to carry out the program as outlined above: Robert Combs, Naples, Fla.; Heber Bell, St. Petersburg, Fla. Archie Turner, Naples, Fla.; Arthur H. Todd, St. Petersburg, Fla.

To act in an advisory capacity to the Committee the following were appointed: Dr. F. G. Walton Smith, Miami, Florida; Honorable L. C. Yeomans, Crystal River, Fla.; Mr. Wendell C. Heaton, Tallahassee, Fla.

Although this program was not entirely to the liking of the commercial fishermen, since they felt that the license fees were too low, and no provision was made to take the Conservation Department out of politics, it was their belief that jointly it could be implemented and the economic condition of the commercial fisherman improved to some extent.

Although the fish dealers insisted on the changes made in the original program and voted to support it, when it was attempted to get action to have the necessary bills prepared, the matter was delayed. The Florida Wildlife Federation asked the commercial fishermen to support a plan for a salt water fish commission composed of five men. A meeting was held on March 16, 1949 at St. Petersburg. Commercial fishermen and fish dealers and the Florida Wildlife Federation were represented, the Florida Commercial Fisheries Association, the Florida Wildlife Federation and the Florida Brotherhood of Fishermen participating.

The purpose of this meeting was to bring the largest organized groups of interested parties together in an attempt to reconcile differences of opinion and to produce a unified program for the preparation of legislation on salt water conservation to be presented at the Legislature in Tallahassee.

The Florida commercial fish dealers recommended that the appointment of the Supervisor of Conservation be taken out of the hands of the Governor and be made by a majority vote of the cabinet. They recommended that all fishing laws be enforced and that the legislators give all local and special fishing laws resented close attention and consideration before passage.

The Florida Wildlife Federation's proposal was to establish a Salt Water Fish Commission, composed of five Commissioners. The dealers' delegates opposed the setting up of a Salt Water Fish Commission. The Florida Brotherhood of Fishermen would not approve the Commission plan unless some changes were made, providing that at least two of the commissioners be experienced commercial fishermen, that the commissioners have a per diem allowance, and that the commission be guided by the findings of the Marine Laboratory of the University of Miami in promulgating their regulations. This was agreed on, and drafts of the necessary legislation for presentation at the coming session of the Legislature were ordered. The support of the Florida Wildlife Federation was asked on three bills to be presented by the Florida Brotherhood of Fishermen.

(1) That resident commercial fishermen be licensed at \$5.00 per year and that alien or out of state commercial fishermen be licensed at \$50.00 per year. (2) That sport fishermen be licensed at \$1.00 per year and that a reasonable bag limit be imposed. (3) That the 6c gasoline tax on gas used in commercial fishing craft be removed.

The Florida Wildlife Federation agreed to support these measures.

Despite these agreements the bills were not prepared as planned and none was approved by the Legislature. Thus progress in improving our salt water fisheries and the social and economic states of commercial fishermen has once more been delayed.

FRIDAY—NOVEMBER 18

Chairman—CLARENCE P. IDYLL, Research Associate,
Marine Laboratory, University of Miami,
Coral Gables, Florida.

Development of the Gulf States Marine Fisheries Compact

BERT E. THOMAS, *Chairman, Gulf States Marine Fisheries Commission*

THE FORMATION of the Gulf States Marine Fisheries Commission is a subject of vital importance to the fisheries of the Gulf of Mexico. The Gulf of Mexico stretches for more than 3,000 miles along the coasts of Florida, Alabama, Mississippi, Louisiana and Texas. Within the 716,000 square miles of water there are tremendous resources in oysters, shrimp and many species of fish. These resources enrich the diet of millions of Americans and are the means of livelihood for thousands of citizens of the Gulf States.

For many years marine biologists and fisheries experts of the Gulf States have felt that a greater degree of interstate cooperation in developing the Gulf Fisheries resources would be of benefit to all of the Gulf States. The advantages to be gained for these fisheries by linking the Gulf States together in a formal, permanent compact was demonstrated clearly at the national Intercoastal Conference held in Washington in May, 1946. This conference, attended by representatives of the Gulf, Atlantic and Pacific coast states, was called to consider the implications of a Presidential proclamation which had the effect of extending the national interest in fisheries to the continental shelf and beyond. It was apparent during the Conference that the states of the Atlantic Seaboard, through the Atlantic States Marine Fisheries Commission which they organized in 1942, were in a strong position to safeguard their interests with respect to the Federal government and international treaties and conventions. This unity has enabled the Atlantic Coast States to develop effective, coordinated programs for increasing their fisheries resources.

The three states bordering the Pacific Ocean perfected a similar compact in 1947, so that now the chain of interstate cooperation among the coastal states forms a continuous band from the State of Maine around to the State of Washington. There is much current talk concerning the organization of a fisheries compact among the states bordering the Great Lakes, and it is thought that within the next year or two such a compact will, in all probability, be perfected.

At the request of the Gulf States the Council of State Governments called a meeting of conservation and seafood agency officials from the Gulf area at New Orleans on October 10, 1946. This meeting considered plans for establishing a Gulf fisheries commission, and arranged to reconvene in New Orleans on December 5-6th with the Attorneys General and Commissions on Interstate Cooperation of the five states present. At the December meeting a preliminary draft of a Gulf State Marine Fisheries Compact was prepared.

A final draft of the compact was completed on April 10-11, 1947, in New Orleans. Present at this meeting were legislators, Attorneys General, conservation officials, fisheries representatives and Interstate Cooperation Commissioners. The Compact was referred to the five states for enactment, a Continuing Conference Committee was created to remain in existence until the Compact Commission was organized formally and the Council of State Governments was requested to serve the Conference Committee as secretariat during the period prior to formal organization.

The purpose of the Gulf States Marine Fisheries Compact thus drafted was declared to be: "To promote the better utilization of the fisheries, marine, shell and anadromous, of the seaboard of the Gulf of Mexico, by the development of a joint program for the promotion and protection of such fisheries and the prevention of the physical waste of the fisheries from any cause." Briefly, it is an advisory and recommending body composed of three representatives from each of the member states.

The Commission is empowered to obtain necessary staff and officers and to inquire into and report on methods, practices, circumstances and conditions relative to the prevention of depletion and physical waste of the Gulf Fisheries. It is empowered, also, to recommend the coordination of state police power and to draft and recommend legislation to further the basic purposes of the compact. It is expected that the joint interstate commission created by the Compact will prove to be an excellent medium for developing recommendations for eliminating trade barriers affecting the Gulf States and their fishermen as a result of licensing difficulties.

The Compact named the United States Fish and Wildlife Service as the primary research agency of the Commission, and designated that it cooperate with the research agencies in each of the member states.

The financing provisions of the Compact are contained in Article 12. They provide for an estimated initial working budget of \$13,000, prorated among the five Gulf States. This does not include travel costs and necessary expenses of the three Commissioners from each state, since such costs are to be borne by the respective member states, in a manner most acceptable to it.

Florida and Alabama adopted the Gulf Compact in 1947. Louisiana, during its regular 1948 session of its Legislature, became the third member state. The Texas Legislature passed the enabling act in 1949. It is hoped that Mississippi, whose Legislature did not meet this year, will take similar action at the next special session, or during the regular 1950 session, and thus complete the roster of member states.

Under the provisions of Article I, Section 10 of the Constitution of the United States, no two or more states can enter into a compact without the consent of Congress. This consent was given by Public Law 66, 81st Congress, signed by the President of the United States on May 19, 1949. On that day, the Gulf States Marine Fisheries Commission came into being.

Arrangements for obtaining necessary legislation, and other activities affecting the development of the Gulf States Marine Fisheries Compact have been handled by the Continuing Conference Committee and the Council of State Governments. Two meetings of the Continuing Conference Committee have taken place since the Compact was drafted—at the Edgewater Gulf Hotel, Edgewater, Mississippi, on May 27-28, 1948, and at New Orleans on October 11, 1948.

A final meeting preparatory to the formal organization of the Compact Commission was held at Montgomery, Alabama, on May 27, 1949. Representatives

of the five Gulf States met at that time as a Committee on Arrangements to develop necessary plans for the signatory meeting at Mobile, Alabama, on July 16, 1949. On that date the Commissioners of the member states met and witnessed the formal signing of the Compact by Governor James E. Folsom of Alabama. The machinery was thus set in motion to accomplish the purposes for which the Compact was intended. An organizational meeting was held at Houston, Texas on the 13th and 14th days of October, 1949, when rules and regulations for the Commission's procedure were adopted. The services of a permanent Secretary-Treasurer were secured and headquarters for the Commission was established at New Orleans, Louisiana. Arrangements were discussed whereby our research agency, the U.S. Fish and Wildlife Service, would place in operation two vessels in the Gulf waters to conduct an intensive research and exploratory program.

In conclusion, it should be stated that great things are expected to arise out of our Gulf States Compact. The intimate association with such an outstanding organization as the Gulf and Caribbean Fisheries Institute and its splendid work should prove of untold benefit to the Commission in its attempt to promote the better utilization of the fisheries of the Gulf Seaboard. The Commission is looking forward eagerly to a record of achievement. It is hoped that many vexing problems which are common to the Gulf States can be solved by providing a central forum where representatives of the states concerned can discuss these problems until satisfactory answers are attained. A thorough program of exploration and research should provide fisheries information which will be invaluable to the commercial industry as well as to the State Conservation Agencies which are charged by law with the duty of preserving and protecting the marine, shell and anadromous fisheries of the Gulf of Mexico.

The Atlantic States Marine Fisheries Commission and the International Conference on the Northwestern Atlantic

WAYNE D. HEYDECKER, *Secretary Treasurer*
of the Atlantic States Marine Fisheries Commission

EARLY IN 1945 there was evidence of growing concern about possible increase in fishing pressure on stocks of fish supporting international fisheries like those of the Newfoundland Banks. At the same time there were reports of possible future treaties that might be negotiated with respect to such fisheries.

Accordingly the Executive Committee of the Commission, meeting in New York on February 23, 1945, authorized the Chairman to appoint a committee to inform the U.S. State Department of the interest of the Commission in such matters and of its desire to participate therein. Such a committee was appointed and it met with officials of the State Department and the U.S. Fish and Wildlife Service at the State Department on April 3, 1945. At that meeting the committee urged the Department to establish some procedure for consultation with the states on a regular basis with respect to conservation matters affecting the states and cited as precedents the treaties affecting halibut, salmon, and migratory birds and the treaty relating to the Great Lakes.

The committee pointed out the advisability of keeping the states continually informed of progress on such matters because in the last analysis enforcement and administration are best accomplished at the points of landing. After a fu

discussion of these points no formal conclusions were reached, but no marked differences of opinion developed.

In September of 1945, the Fourth Annual Meeting of the Commission adopted unanimously a resolution patterned on one adopted in August by the New York Joint Legislative Committee on Interstate Cooperation, asking the creation of such a permanent channel of communication to the states. The resolution is too long to present in full. Briefly, it recited the dangers that might arise if states, in the protection of their own interests, were compelled to oppose ratification of a treaty or to insist on crippling reservations, as has frequently happened in the past. It urged the Council of State Governments and the Governors Conference to use their influence to bring about a suitable permanent method of consultation by the federal government with the states, on matters which tend to impinge on the field of activities that have traditionally been the function of state governments, and it asked the Commissions on Interstate Cooperation in the several states to back this proposal.

It is interesting to note that on the same day in Washington, President Truman issued two proclamations relating respectively to the mineral resources of the continental shelf and the fisheries in waters contiguous to our coasts. The latter proclamation asserted the propriety of unilateral action by the United States to establish conservation zones for such fisheries developed by nationals of the United States alone, and the willingness of the United States to establish such conservation zones by joint action with our other governments where such fishing activities have been or may hereafter be developed and maintained jointly by nationals of the United States and of other nations. This fisheries proclamation also conceded the right of other nations to establish conservation zones in accordance with the principles above enunciated.

The assertion of national policy in such proclamation by the President gave added emphasis to the request made by this Commission for the establishment of an appropriate permanent liaison procedure between the federal government and the coastal states, because the scope and content of any international agreements that may be entered into are of vital concern to the coastal states, and are matters on which they are entitled to be consulted and to participate in formulating policy. Moreover, the effectiveness of the enforcement of the provisions of any such international agreement depends in no small measure upon the cooperation of the fishery administrations of the several states.

Further impetus to the movement for state participation in treaty making initiated by the Atlantic States Marine Fisheries Commission was given by the Exploratory Intercoastal Conference called by the Commission in Washington on May 16 and 17, 1946. This conference was attended by representatives of ten states from the Atlantic Coast, two from the Gulf Coast and two from the Pacific Coast. Six of these states were also represented by their Attorneys General or their deputies. At this Intercoastal Conference a resolution was adopted asserting that "under our federal system effective utilization of international treaties is dependent on the development of federal state cooperation." Accordingly the resolution went on to ask that in the steps leading up to the negotiation of a treaty the states be consulted and that in the negotiations themselves and in any international commission or agency established for regulatory or administrative purposes, the states be afforded opportunity to participate by suitable representation.

With respect to all of these matters, it should be made clear beyond the possibility of misunderstanding that the interest of this Commission and its activities in this field of federal-state relationships have been inspired by no

hostility to the agencies of the federal government and by no slavish adherence to the academic doctrine of states rights, but rather have been actuated by a sincere recognition on the part of the state officials in this Commission, that under our federal system there rest upon the states responsibilities long established by judicial decision.

During 1947 the Pacific Fisheries Conference, representing the industry on that Coast, sponsored a strong movement for the creation of the post of Assistant Secretary of State for Fisheries. The Atlantic States Commission endorsed the proposal. The objective sought was not secured in full but a special fisheries office was created with the title Special Assistant to the Under Secretary of State. Dr. Wilbert M. Chapman, Director of the School of Fisheries of the University of Washington, was appointed to this post and has filled it with distinction. Prior to Dr. Chapman's appointment the fisheries unit of the State Department, headed by William E. S. Flory, in numerous confidential conferences with officers and committee members of the Commission, had discussed various suggestions then being considered in relation to a proposed treaty on the Northwestern Atlantic. After Dr. Chapman's appointment these cordial conferences were continued. On at least three occasions Dr. Chapman or Mr. Flory and other representatives of the State Department at closed meetings of the Commission discussed in detail the latest tentative draft of the proposed treaty on the Northwestern Atlantic. The Commission in turn arranged individual conferences with the administrators in all states affected and with groups of industry representatives, and accompanied representatives of the Department on two trips through the states directly concerned. Out of these conferences arose suggestions, many of which were incorporated into subsequent drafts of the proposed treaty. In a very real sense, therefore, the states participated actively from the beginning in the determination of the United States position and the preparation of the draft of the treaty offered to other nations.

When the eleven nations concerned were invited to assemble in Washington in February 1949 to negotiate the Convention or Treaty, the State Department invited the Commission to suggest three persons to serve on the United States Delegation: One as a plenipotentiary and two as advisory members. Because of his long association with the State Department, the Commission recommended its Special Advisor, Frederick L. Zimmermann as plenipotentiary member, and Richard E. Reed, Commissioner of Sea and Shore Fisheries of Maine, and Wayne D. Heydecker, Secretary Treasurer of the Commission as two advisory members. All three were appointed to serve on the United States Delegation, and took an active part in the Delegation meetings where day-to-day strategy was developed as the conference proceeded. They were also active in fulfilling assignments made by Dr. Chapman as head of the Delegation. At an international conference, after the preliminary position of each government is made known, the actual negotiations customarily involve the winning of support from members of other delegations for points deemed essential and the making of such concessions on other matters as are necessary to obtain agreement on major objectives. Dr. Chapman, on several public occasions, has been good enough to declare that the assistance rendered to the State Department by this Commission and its representatives from the beginning of the operation to the completion of the Treaty and its final ratification by the United States Senate has been most helpful and significant.

It will thus be seen that through the generous cooperation of the State Department, representatives of the states through this Commission were afforded the opportunity of participating in the preliminary discussions leading up to the

draft of the treaty, and in the actual negotiation of the treaty with representatives of foreign governments. Two of our three original objectives were thus fulfilled. The one remaining request made by the Commission at the first conference in 1945 was that, in the final international body created to administer the treaty, there should be in the U.S. Delegation a representative of the state viewpoint. In the implementing legislation proposed by the State Department and approved by a special committee of this Commission following a meeting in Boston on May 9, 1949, recognition is given to the remaining points stressed by the states, namely, the implementing legislation provides for state representation on the International Commission and contains a clause to safeguard state jurisdiction in the following terms:

"Section 9

"Nothing in this act nor in the Convention shall be construed to impair the fishery jurisdiction of the several States, nor to prevent in any way the several States from giving protection to stocks of fish not covered by regulations adopted by the United States pursuant to proposals of the Commission, nor from giving additional protection to those stocks of fish covered by such regulations."

In that form the bill has the unqualified endorsement of the Commission for it believes that the provisions quoted adequately safeguard the interests of the states.

It is appropriate to say that the developments herein described represent a new high in federal-state cooperation. At every point from the first meeting in 1945 to the signing of the Convention and the preparation of the implementing act there was involved not only the cooperation of the State Department but also that of the U.S. Fish and Wildlife Service, whose staff members acted as advisors both to the State Department and to the Commission. The pattern of cooperation thus established has already served as a precedent for similar cooperation among the State Department, the Fish and Wildlife Service, and the states of the Pacific Coast in the negotiation of two treaties also recently ratified by the Senate, dealing with the tuna fisheries of the Pacific Ocean off the coasts of Mexico and Costa Rica. From a national viewpoint the results of such federal-state cooperation are of even greater significance.

As a result of state participation through the medium of the Atlantic States Marine Fisheries Commission, one of the most ambitious fisheries treaties in the history of the world has been speedily ratified by the United States Senate without a single reservation or dissenting vote. Contrast this with past history with respect to fishery treaties where delay, frustration, and weakening reservations have been all too frequent because of past failure to recognize the importance of state participation in our federal-state system. It is only necessary to cite the delays caused by the State of Washington in the ratification of the Sockeye Salmon Treaty, and delay and reservations insisted on by that state with respect to the Halibut Treaty. More recently, opposition by Ohio has blocked the ratification of the Great Lakes Fishery Treaty still pending in the Senate.

The last four years have established a new pattern that augurs well for the future. It has been demonstrated that state participation and federal-state cooperation functioning through an effective cooperative interstate agency have given a new vitality and new significance to our federalism. That pattern of federalism established by our forebears is not outmoded. On the contrary, it works smoothly, rapidly, when its constituent parts are synchronized. With effective use of the interstate fisheries commissions now established on all three

coasts and with the precedents established in the treaty on the Northwestern Atlantic, there is every reason to believe that effective federal-state cooperation in these matters will be the pattern of the future.

Potential Products From Gulf or Sargassum Weed

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IN THE 1948 ANNUAL of the magazine, *Southern Fisherman*, it was said, "One of the least publicized and underexploited . . . yet one of the most valuable marine resources of the world is seaweed." This is just as true of the Caribbean area as of any other, and a few words regarding the possible utilization of the seaweeds are certainly not out of order.

The Caribbean area has various kinds of seaweeds, but this paper is limited to comments on one, the brown marine alga, *Sargassum*, perhaps more commonly known as Gulf Weed. Actually there are two types. One is attached to the bottom and grows along the coast in comparatively shallow water. So far as is known there are no large beds of this type and it is, therefore, not likely to become of much importance. The other type of *Sargassum* is free floating and is found in the Sargasso Sea and the Atlantic west of there, in some parts of the Caribbean Sea and in the Gulf of Mexico.

A study of the literature discloses that the brown algae, in general, are sources for algin, among other constituents. This study of *Sargassum*, one of the brown algae, has been directed primarily to determine the amount of algin available and the best methods of recovering it, but with consideration of the other constituents also.

Parr, in a paper titled "Quantitative Observations on the Pelagic *Sargassum* Vegetation of the Western Atlantic," has given the only general report on the availability of the floating *Sargassum*. He states that the Sargasso Sea includes about two million square miles and that floating *Sargassum* averages 2 to 5½ tons per square mile. On the other hand, he estimates floating *Sargassum* in the Gulf of Mexico to average one ton per square mile for a total of 90,000 tons. Furthermore, it is indicated that the seaweed in the Gulf is the result of fresh weed floating in from the Atlantic. Hence there is a large quantity of Gulf Weed available, and probably concentrated in several places so that it would not be too difficult or expensive to harvest. Collection of a floating seaweed would be much easier than mowing of an attached and perhaps submerged one. Some of the beaches of the Atlantic and Caribbean islands should be good for collection of *Sargassum*.

Is it worth collecting seaweed generally for colloid materials? Samples have been taken of both the fixed and the floating varieties of *Sargassum*. Complete analysis has been made of the former. Determination of algin, laminarin, mannitol, and fucoidin have been made on both types on actual separation of these constituents. At the present time there is underway at the Marine Laboratory of the University of Miami a year-round monthly analysis for these main constituents in the floating *Sargassum*, along with other simpler sugar materials. Obviously, for any commercial utilization it is necessary to know all about any variations in the amount of algin and other substances available.

Analyses show the fresh *Sargassum* to be about 85 per cent water and the air-dried seaweed about 15 per cent moisture. On the dry basis it averages 17

per cent algin, less than one per cent mannitol, 4 per cent fucoidin, and no laminarin. The algin content is an average for a considerable part of the year, actual figures having ranged from 13 per cent to 23 per cent. The others are reported on one sample of a fixed Sargassum. Fat content was about one eighth of one per cent, proteins 4 per cent.

Algin is the important constituent in this study. In the United States alone, several million pounds are used yearly and the demand is growing. Alginic acid is used in the manufacture of fibers, thickeners, protective colloids, and in insulating materials. The sodium salt, usually called Algin, and the calcium salt have been used in the production of textiles, plastics, transparent paper, cosmetics, films and coatings, ice cream, salad creams, custards, jams, sauces and jellies, and as an emulsifier in pharmaceutical, medical, and surgical preparations. Other uses are being frequently reported. Fucoidin has no known use at present but it may prove similar to agar. The protein and fat in Sargassum are of little value, as such. But Sargassum, dried and washed free of some of the salt, can be used as a cattle feed and has been reported to have a fairly high digestibility factor.

Dried Sargassum can be used as a fertilizer material. The minerals extracted during the production of algin can be recombined with the spent weed and this used as a fertilizer. Properly prepared Gulf Weed is a good mulching material, since the colloidal materials present will hold large amounts of moisture.

In any discussion of ways for increasing the available foodstuffs, consideration should be given to the fermentable sugars obtainable from Sargassum. As with such sugars from other sources, the extract of the Sargassum can be used as a liquid on which to grow high-protein yeast. This yeast can be dried and used as a protein supplement in human nutrition. Since the sugar solution can be obtained before extraction of the algin, it is possible to obtain two products from the same lot of Sargassum.

From the 90,000 tons of Sargassum which Parr has calculated is present in the Gulf of Mexico, and estimating that this quantity will produce 12 or 13,000 tons dried, recovery of 15 per cent algin would produce close to 2,000 tons of this material, or about four million pounds. Of course, it would not be possible to harvest all the weed in the Gulf, but if it is true that the supply there is replenished by fresh weed floating in from the Atlantic, it is possible that somewhere near the tip of Florida there is a good place for collecting Sargassum in large quantities. There might also be such a place near Nassau. The process of extraction and purification is neither difficult nor expensive, and it is probable that a worthwhile industry can be built up on this one seaweed.

The Place of Systematics in Commercial Fisheries Research

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BEFORE DISCUSSING the part played by systematics in fisheries research, a few words should be said about the modern concept of, and approach to, systematics, especially in what concerns the study of fishes.

In the "old days," from about the time of Linnaeus until very recently, the practice of taxonomy consisted in the morphological study of single or, at the most, very few individuals collected by miscellaneous persons. In most instances, these specimens were not even accompanied by a locality label. Few, if any, natural history notes were taken in those days. In other words, an "ichthyolo-

gist" was an individual who studied the morphology of a dead, sometimes not too well preserved, fish, published a very brief description of it, and that was that. If the locality was given at all, it was usually expressed as "Atlantic Ocean," "North America," "West Indies," etc. The discovery of geographical variation brought about the necessity of more precise locality indications, but not until recently did the necessity of knowing the precise locality become apparent through refined racial studies.

For obvious reasons, the practice of establishing species on single or few individuals from single localities was also shown to be highly inaccurate when geographical variation was brought to light. Many of the previously described species considered as "good" for many years have been, and are continuously being found to be, mere local variations of a single species, often not even with a subspecific value.

Analytical keys designed for the rapid and practical identification of species were also based on single individuals, with almost complete negligence of ontogenetic and geographical variation. The result has been that at present most of the keys written up to some years ago are (as they were then) of little, if any, value. A good example of this is found in Jordan and Evermann's "Fishes of North and Middle America," in which most of the keys to species are based on single individuals and not even the length of the specimens is given.

In recent times, most taxonomists have realized the necessity of studying series of individuals, containing as many age groups as possible, in interpreting a species or group of species. But a mere study of morphological characters is not enough. Taxonomists are also interested in the relationship between species and groups of species. This leads to the establishment of basic factors in interpreting their phylogeny and origin, and the speciation processes through which the species came about, i.e., their evolution.

Divergence in morphology, the basis for taxonomy, also means divergence in ecology, physiology and behavior. In many instances this latter type of divergence may be better marked and more important than mere morphological divergence. So-called physiological and ecological species are good proof of this. The importance of incorporating such disciplines as ecology and physiology becomes apparent in the difficulty that frequently arises in interpreting certain forms known to be morphologically affected by certain environmental factors, namely, temperature, salinity, turbidity, etc. The effect of temperature on the size and number of vertebrae in fishes is well known, as well as that of salinity on size and coloration. There are many problems of species interpretation which can be solved only through experimental ecology in the field as well as in the laboratory, in order to establish definitely whether presumably distinct forms are truly separate genetic entities or mere ecotypes of one single form.

The fishery biologist is interested in learning about the habits and distribution of fishes (their life histories) for the practical purposes of commercial exploitation and conservation. But in order to do the job right he must be sure of the taxonomic entities with which he is working, since, as already pointed out, even in the lowest taxonomic ranks (subspecies, races, populations) great divergence in habits may be observed. It is the job of the systematist to provide the fishery biologist with this information.

It has been said earlier in this paper that modern taxonomy is concerned with *series* rather than with single individuals, and it is a well known fact that fishery biology is even more concerned with series of individuals—in fact with populations. It becomes apparent, then, that the fishery biologist can provide invaluable information to the taxonomist, not only by supplying him with large

series of specimens, but by learning about their habits and distribution which are factors that have been found to be basic in the accurate interpretation of a taxonomic entity. At the same time, the fishery biologist will benefit by the accurate taxonomic interpretation based on the information supplied by him.

Poor work on the part of systematists in the early days of fishery biology brought about the development of so-called "racial studies" in the field of that discipline, in order to obtain a better interpretation of populations below the species level. Great improvements in taxonomic methods resulted and these have been incorporated to the practice of modern taxonomy in many branches of zoology. At present, with the improvements and refinements available in systematic ichthyology, racial studies should be left to the taxonomist, releasing in this manner the fishery biologist to his more important duties of investigating the other phases of the biology of fishes.

Fishery biology and taxonomy are mutually complementary. Basic training in systematics is as important to the fishery biologist as basic training in the general biology of fishes is to the systematist. Fishery biologists and taxonomists have usually worked independently and have regarded each other as separate and inferior castes. It is necessary to realize that these two branches of ichthyology have a great deal in common and are dependent on each other.

The Effects of Underwater Seismographic Exploration

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THE PROBLEM of the lethal effect of underwater explosions to aquatic life has been accentuated by the necessity of the employment of this means of searching for oil deposits. These phenomena are paralleled by war use of underwater explosions for the destruction of enemy submarines.

The necessary employment of this technique in the onshore and offshore waters of the State of Louisiana caused deep alarm among those citizens who were concerned with five major marine enterprises, viz., recreational fishing, commercial fishing, the oyster industry, the shrimp industry and the crab fishery, both hardshell and softshell.

It was imperative that a sound basis be established that the use of these seismographic techniques would not seriously impair such aquatic resources.

Therefore, three series of controlled experiments were devised and executed to ascertain in what manner these highly important marine resources of Louisiana would be affected by the use of submerged explosive charges in exploration.

The problem proved to be extremely complicated.

The first series of experiments was executed in duplicate and involved the discharge of a top shot of 800 pounds of the explosive seismographically used which deviated less than 4 per cent from the impact of trinitrotoluol. Graded lesser charges were subsequently used. Shrimp (*Penaeus setiferus*), fish, croakers, (*Micropogon undulatus*) and oysters (*Ostrea virginica*) were used, the experimental animals being placed in carefully constructed cages at intervals of 50, 100, 150, 200, 300 and 400 feet. The most careful consultation was conducted with physicists to establish that these confining cages, constructed with extremely small slats, could not possibly cushion any explosive impact. As already stated, this series was fired in duplicate.

It was revealed that these relatively enormous charges, far in excess of anything normally employed, left completely unharmed shrimp at 50 feet, oysters

at 50 feet and fish at 200 feet. Dr. McCollum, foremost seismographist of the United States, very kindly provided specially designed recording instruments to measure explosion wave impact. The decrement in displacement, which is the critical element, provided a completely unexpected and amazing pattern. Several subsequent days were occupied in firing successive charges to establish data whereby a curve could be plotted.

It seemed quite unreasonable that an explosive discharge that flung water into the air more than 350 feet and shook an oyster lugger ten miles away with a violently perceptible impact could still fail to harm shrimp and oysters at a distance of fifty feet and fish at a distance of two hundred feet.

The initial experiments and the subsequent experiments performed for the purpose of delineating the impact curve showed that the fall in damaging displacement was astonishingly rapid. No measurements could be taken at shot point because of the violent reaction but the curve beyond shot point could be, with reasonable accuracy, calculated from the data actually obtained thereafter. Therefore, the first point (shot point) having been calculated, the stations were actually measured.

Thus stated, 1000 units at shot point, calculated by the extension of rapidly established curves, fell to the following values which were not calculated but actually measured: 100 units at 50 feet, 10 units at 100 feet, 4 units at 150 feet, 2.5 units at 200 feet, 1.9 units at 250 feet, 1.5 units at 300 feet, 1.4 units at 350 feet, 1.1 units at 400 feet and unity at 450 feet.

The slow response of oysters led the writer to carry out a completely separate and comprehensive investigation of oyster mortality due to seismographic explosions. Duplicate series again were used with a top charge of 400 feet of dynamite exploded in the center of the oyster beds with the top dynamite 25 feet below the oysters and with adequate controls. A radial series of oysters was secured with adequate controls and was transferred to the Pensacola Station of the Fish and Wildlife Service. They were there kept under observation for two and a half months and the experimental oyster beds were kept under observation for two and a half years. Briefly stated, results were that, quite surprisingly and beyond the experimenter's prediction, these violent explosions caused no significant mortality either on the animals present or on the animals that subsequently remained. The importance of this is that, quite contrary to the surmise of oyster men, such seismographic explosions caused no subsequent mortality to the oysters, no subsequent damage by the gas originating from the dynamite explosions and no subsequent diffusion of damaging hydrogen sulphide or other gases from the substratal mud.

A third series of experiments was conducted utilizing, in addition to previous experimental animals, the blue crab, *Callinectes sapidus*. It was found that there was no radial seriation in blue crab mortality but that the blue crab deaths were definitely a function of their physiological condition, primarily predicated upon whether or not such crabs had spawned and thus were subject to explosive impact upon vacant spaces in their anatomy.

Correlation of all of these results has been made with previous experimental work, particularly that of Dr. R. H. Draeger, and the results also accord with Dr. Draeger's observations concerning "Operations Crossroads," the Bikini bomb experiments in which Dr. Draeger had primary responsibility for safety. It should be pointed out that these results, some of which were published, were disregarded in a 1948 publication by the Chesapeake Bay Biological Laboratory.

John McDougall and Louis C. Rodrigue collaborated with the writer in the two earlier series of experiments and Dr. Malcolm Owen in the third.

Production of Red Tide in the Laboratory

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IN A PAPER presented at the Institute meeting last year, Dr. Gordon Gunter (1) described general aspects of the Red Tide in Florida. It was mentioned that the 1946-1947 Red Tide, which entailed the loss of millions of pounds of fish, was caused by an outburst of microscopic marine organisms. The organisms were identified as naked dinoflagellates and scientifically named *Gymnodinium brevis* (2,3). Reports of dinoflagellates which have caused similar water discolorations and fish mortalities are available from many parts of the world with recorded occurrences in Florida as early as 1840 (4).

The work to be discussed is a part of a comprehensive research program started about a year ago, on red water developments in this area. Cooperating in the program are the Gulf Investigations, U.S. Fish and Wildlife Service located in Sarasota and the University of Miami Marine Laboratory. One part of the program is a detailed investigation of biological, physical and chemical conditions of Gulf water to detect variations which may possibly be related to Red Tide outbreaks. Another part is the work to be described—a study of methods for growing Red Tide and related organisms in the laboratory. By means of such experimentation under controlled laboratory conditions, it is possible to learn factors which are essential for the growth of the organisms. These same factors may be expected to be required for their existence in the Gulf.

So far in the course of this research it has been impossible to locate specimens of *Gymnodinium brevis*. Another species of *Gymnodinium*, *G. simplex*, and also a Protozoan of another class, a ciliate, *Plagicampa marina*, are employed for the laboratory studies. The organisms were isolated from plankton samples collected in the Gulf. Both are microscopic and have conspicuous green chromatophores as described for *G. brevis*.

Early in the study it was found that *G. simplex* and *P. marina* grew very well in a nutrient composed of sea water, natural or artificial, supplemented with yeast extract. The organisms have been in continuous culture in this nutrient since first isolated nearly a year ago, without signs of waning vitality. The artificial sea water is prepared after a formula of McClendon (5) with minor elements introduced by additions of Hoagland's A-Z solution (6). The fact that other Protozoan taken from the Gulf also thrived in this yeast extract nutrient may recommend it as an enrichment medium for marine Protozoa.

Soon after isolation, *G. simplex* and *P. marina* were made bacteria-free: *Gymnodinium* by use of 2,4-dichlorophenoxyacetic acid and *Plagiocampa*, by particular exposures to ultra violet radiation. The cultures are at present maintained in test tubes incubated at 30° C and subjected to water-filtered light having an intensity of approximately 40 ft. candles for a photoperiod of 12 hours.

On the assumption that these plankton species having chloroplasts live essentially as green plants, with particular requirements of phosphates, nitrates and nitrites, extended studies were made to determine the effects of inorganic phosphorus and nitrogen on their growth. Phosphorus and nitrogen were added to both natural and artificial sea water, with and without yeast extract, in various forms: phosphorus as H_3PO_4 , $K_2 H PO_4$ and $Na H PO_4$; nitrogen as NH_4OH ,

$\text{Ca}(\text{NO}_3)_2$ and NaNO_2 . Concentrations ranged from one to 200 times the amounts of these elements recorded to occur normally in sea water. No growth promoting effects were found for any of the additions made and it was demonstrated conclusively that the cells could not survive in a nutrient containing only inorganic constituents.

In a later phase of the study, the value of yeast extract in sea water for growing *G. simplex* and *P. marina* was found to be attributable to the amino acids of yeast. With this discovery, it is now possible to grow the organisms in

TABLE I
COMPOSITION OF SYNTHETIC MEDIUM FOR GROWTH
OF *G. simplex* AND *P. marina*.

CONSTITUENTS		G/LITER
*a	1. NaCl	26.0000
	2. MgCl ₂	2.2600
	3. MgSO ₄	3.2480
	4. CaCl ₂	1.1530
	5. K Cl	0.7210
	6. NaH CO ₃	0.1980
	7. Na Br	0.0580
	8. H ₃ BO ₃	0.0580
	9. Na ₂ Si O ₃	0.0024
	10. Na ₂ Si ₄ O ₉	0.0015
	11. H ₃ PO ₄	0.0015
	12. Al ₂ C1 ₆	0.0130
	13. NH ₃ (as NH ₄ OH)	0.0020
	14. Li NO ₃	0.0013
*c	15. Fe Cl ₃	} Total
	16. MoO ₃	
*b	17. Co (NO ₃) 2 • 6H ₂ O	
	18. Cu SO ₄ • 5H ₂ O	
	19. ZnSO ₄	
	20. Sn Cl ₂ • 1H ₂ O	
	21. Mn Si • 4H ₂ O	
	22. Ni SO ₄ • 6H ₂ O	
	23. Ti ₂ O	
	24. KI	
	25. Arginine	0.2000
	26. Histidine	0.0500
	27. Isoleucine	0.1500
	28. Leucine	0.2000
	29. Lysine	0.2000
	30. Methionine	0.0500
	31. Phenylalanine	0.1000
	32. Threonine	0.1500
	33. Tryptophane	0.0500
	34. Tyrosine	0.1500
	35. Valine	0.2000
	36. Cystine	0.0500
Total		35.2692
Distilled water to 1000 ml.		
pH = 8.4		

*a Constituents 1-14 modified after McClendon (1917) formula for artificial sea water

*b Constituents 17-24, from Hoagland's A-Z solution for green plants.

*c Preparation of constituents 15-24.

15. FeCl_3	0.080g	} per 100 ml, 1 ml per liter of nutrient.
16. MoO_3	0.007g	
17. $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	0.10g	} per 100 ml, dilute 1:18 and of this, use 1 ml per liter of nutrient solution.
18. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	0.10g	
19. ZnSO_4	0.10g	
20. $\text{SnCl}_2 \cdot 1\text{H}_2\text{O}$	0.05g	
21. $\text{MnCl} \cdot 4\text{H}_2\text{O}$	0.70g	
22. $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$	0.10g	
23. Ti_2O	0.10g	
24. KI	0.05g	

nutrient which is entirely synthetic. The nutrient contains artificial sea water and amino acids added as pure chemicals in ratios analyzed for yeast (7, 8, 9). The exact composition of this medium is given in Table 1.

The amino acid requirements demonstrated by *G. simplex* and *P. marina* lead to a consideration of the classic view of Pütter (10) who endeavored to show that dissolved organic nitrogenous compounds and other dissolved organic matter, play an important role in the nutrition of aquatic organisms. The arguments and observations, pro and con, concerning this important problem, have been reviewed by later investigators, particularly Krough (11). Krough concluded that the large quantity of dissolved organic nitrogenous matter shown by his own analyses to be in solution in sea water, provided there by excreta of animals, decomposition of dead animals, dissolving phytoplankton and other microorganisms, is unsuitable as food for living marine organisms. Thus the

the dissolved material that a microfauna as yet unknown may exist in the sea which is able to utilize material is lost out of organic circulation. Krough does suggest the possibility

In the present investigation it is shown clearly that the marine organisms studied, *G. simplex* and *P. marina*, are not only able to utilize certain organic nitrogenous material when dissolved in sea water, but actually require such substances in their nutrition. This organic nitrogen dependence suggests the possibility that the organisms may be members of that particular fauna in the sea, referred to by Krough, which functions as an important link between the abundant organic nitrogenous material in solution and particulate protein constituents fed on by more complex and larger marine animals. The apparent value of marine microorganisms in this role agrees with conclusions proposed by present-day planktologists (12), that nannoplankton have a critical part in the cycle of life in the sea.

Aside from this academic interpretation of results found to date, a practical application is the provision of a basis for recommending an investigation of dissolved organic nitrogenous matter in Gulf water as a clue to outbursts of Red Tide dinoflagellates.

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The Fisheries of the Antilles*

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FISHERIES are not organized in the Antilles but are carried on by the inhabitants of the region with small boats and primitive gear which the fishermen construct themselves.

The type of boat most often encountered is the "gommier." It is hollowed out of the trunk of a tree, ordinarily a gumtree, from which the name is given to the boat. The gommier is cheap and has good qualities: lightness, strength, speed, insubmersibility, but also grave faults. The gommiers used for fishing are very narrow, and rarely exceed a ton in capacity. They have great instability and overturn very easily. The gommiers are used at Martinique, at Dominique and Guadeloupe by the negro fishermen.

At St. Martin, St. Barthelemy and at the Saintes, the boats are less primitive: they are canoes, but not as pointed as those seen in the French fishing ports. These are also used on the east coast of Guadeloupe. These boats, more costly than the canoes, are very light and fast and hold the sea well; they sometimes leave the coast and face the quite strong seas of the channels of Dominique and Guadeloupe.

The gear is made by the fishermen. Some of it recalls that of the natives of the east coast of Africa and is very primitive. The following gear is used: trolling lines, set lines, traps, and nets of various kinds.

The natives of Martinique and Guadeloupe are excellent swimmers and divers, and commonly practice this type of fishing. By this means they capture spiny lobsters, conchs (*Strombe*), helmet shells and sometimes turtles.

Fishing by traps is most prevalent in the Antilles. This type of fishing is best adapted to the majority of depths actually exploited and also to the temperament of the inhabitants. Traps of many different forms and sizes are constructed by the fishermen. They are of wood or of metallic screen, which has the advantage of being lighter and more solid. They have one or two entrances. The trap, weighted at its lower part by big stones, is anchored in shallow water, most often not baited. When baited, it is ordinarily with lobster, with sea urchins, with fish or fruit (oranges or mangoes) or fragments of white dishes.

In shallow depths, about 6 to 8 metres, traps are anchored without buoys, in order to remain unseen, since little confidence exists between fishermen. The traps are recovered by aid of a gaff or a grapple.

The most important and the most productive fishing method is seining, which is done on certain parts of the shore where the working of this gear is possible without too much damage. Next in importance is the fishery with the straight net of which the dimensions vary according to the region. The mesh size depends on the size of the fish caught.

The Antillian fishermen also use explosives and poisonous plants. They make their own explosives which they place in bottles or tin cans. They use these in the isolated creeks and cause a heavy mortality of immature fish without making large catches of salable fish. The fishermen are very familiar with the poisonous plants which abound in their forests and on their coasts, and which they utilize to intoxicate the fish. They employ this mode of fishing on the coast and more particularly in the rivers. These customs are disastrous because of the general destruction of young fish which they cause.

* Extract of a translation of the report. Read by M. Taillart, l'Administrateur Principal de l'Inscription Maritime de la Martinique.

On board boats the fisherman sometimes puts a palm leaf over the fish which he has captured to protect them from the heat of the sun. But most often he is content to sprinkle a little sea water over them. This water is 28°-29°C in May to July. The fish are never cleaned on board, so that they become soft very easily if the fisherman's return is delayed or if they are not sold the same day. The nearness of the fishery areas permits them to arrive usually in a good state of preservation. Much of the fish is captured by seine or very close to the coast in the traps; the big fish, tunas, dorados, tazor, are taken by line in the morning a short distance from the coast, and are sold a little later in the first hours of the afternoon.

Consumption of fresh fish is limited to the coastal cities and the villages of the fishermen. Despite the short distances which separate the coastal villages from the interior, and the great number of trucks which circulate in the islands, fresh fish does not reach them. Even villages situated on the coasts of the islands are often deprived of it. They are supplied, when time permits, by fishermen of neighboring villages, the small number of these crafts not being able to satisfy the demand of local consumption.

Because of the fault of the organization of the fishery and of transportation, and the employment of gear and procedures badly adapted to the richness of the surrounding waters, a great part of the population lacks fresh fish, and is obliged to import salted and canned fish.

In the little islands, like Saint Barthelemy, Saint Martin, the Saintes, and Marie-Galante, where the boats are more modern and of greater capacity, and the fishermen more active than at Martinique and Guadeloupe, production often surpasses the local ability to absorb it.

In the Antilles, the fish is sold on the beach, at the market, or in exceptional cases in a local specialty shop.

The principal edible marine animals of the Antilles are listed at the end of this paper.

It is not possible to give even an approximation of the quantity of fish landed in the Antilles. There exist no statistics on the subject.

Antillian fishermen have very few needs and only exercise their energy to satisfy them. They habitually work only enough to assure their food for the day, and to replace some of their gear from time to time. If fish are scarce they go out regularly. If fish are abundant, they rest for a number of days proportionate to the catch which they have made. Sometimes they will visit nearby traps, but they will not continue their fishing, no matter how good fishing has been. To increase the fishermen's production it would be necessary to change their mentality and to strive against their natural laziness by the creation of new needs. It would also be necessary to develop their tendency to act in groups, which is manifested on certain occasions.

Sometimes a whole village will assist in hauling a beach seine and share in the catch as payment for their efforts. Similar cooperative effort is put forward when the turtles appear on the beach to spawn, the men taking turns in watching for the appearance of these animals. One can develop the need for unity and for group efforts on the part of the fishermen by showing them all the advantages that they would receive from it.

The fishermen are unanimous in declaring that the materials which they use cost too much. A cooperative would have a double advantage, in suppressing certain abuses and in safeguarding the maritime rights of fishermen. It would also be able to function in the sale of sea products. The fishermen who are used

to this group activity will accept more easily the necessary reforms for the increase of production.

An increase in size of boats will permit the capture of larger and more fish, and the use of new gear. This will enlarge the range of action, will extend the fishery to species not used until it will give a greater security to the fishermen. The installation of auxiliary motors will be realizable and will follow sooner or later, and will permit greater regularity of supply at the markets.

EDIBLE FISH OF MARTINIQUE

FRENCH COMMON NAME	*ENGLISH COMMON NAME	*SCIENTIFIC NAME
Anguille	Eel	<i>Anguilla bostoniensis</i>
Balaou	Ballyhoo	<i>Hemiramphus brasiliensis</i>
Banane	Tenpounder	<i>Elops saurus</i>
Barbarin	Yellow goatfish	<i>Upeneus martinicus</i>
Bayole	Tang	<i>Acanthurus hepatus</i>
Becune	Barracuda	<i>Sphyræna barracuda</i>
Blanche	Mojarra	<i>Gerres rhombeus</i>
Blanche forme allongée	Mojarra	<i>Gerres cireneus</i>
Bonite dorsales écartées	Frigate mackerel	<i>Auxis thazard</i>
Bonite ventre rayé (Thon bariolé)	Artic bonito	<i>Katsuwonus pelamis</i>
Bracou	Snapper	<i>Lutjanus</i> sp.
Brochet	Snook	<i>Centropomus undecimalis</i>
Brochet petite taille	Snook	<i>Centropomus ensiferus</i>
Capitaine	Hogfish	<i>Bodianus rufus</i>
Carangue	Blue runner	<i>Caranx ruber</i>
Carangue grasse	Pompano	<i>Trachynostus glaucus</i>
Carangue plate (Sapatere)	Jack crevalle	<i>Caranx hippos</i>
Carangue-Lune	Leather jacket	<i>Oligoplites saurus</i>
Carneau	Lookdown	<i>Vomer setapinnis</i>
Carpe bleue	Mullet	<i>Mugil brasiliensis</i>
Chirurgien	Parrotfish	<i>Sparisoma aurofrenatum</i>
Coco	Tang	<i>Acanthurus bahianus</i>
Codinde	Whitemouth drummer	<i>Micropogon furnieri</i>
Coffre a cornes	Trunk fish	<i>Exocostus bahiensis</i>
Congre bariolé	Conger eel	<i>Lactophrys tricornis</i>
Congre verte	Conger eel	<i>Lycodontis miliaris</i>
Crapaud	Scorpion fish	<i>Lycodontis virescens</i>
Creole or Tijò		<i>Scorpaena plumieri</i>
		<i>Paranthias furcifer</i>
		<i>Serranus creolus</i>
Coulirou	Bigeye scad	<i>Trachurus crumenophthalmus</i>
Couronné	Grouper	<i>Petrometropen cruetentus</i>
Couronné rouge	Grouper	<i>Epinephelus adsensiois</i>
Dorade	Dorado	<i>Coryphaena hippurus</i>
Germon	Albacore	<i>Germo alalunga</i>
Goréte	Caesar grunt	<i>Haemulon carbonarium</i>
Grand écaille	Tarpon	<i>Megalops atlanticus</i>
Grands-Yeux	Lane snapper	<i>Lutjanus synagris</i>
Gueule-rouge	Grunt	<i>Haemulon plumieri</i>
Hareng	Thread herring	<i>Opisthonema oglinum</i>
Juif	Catalufa	<i>Priacanthus arenatus</i>
Kiakia or Quiaquia	Scad	<i>Decapterus sanctae-helenae</i>
Languiale		<i>Athlennes hians</i>
Maquereau	Mackerel scad	<i>Decapterus macarellus</i>
Marignan	Squirrelfish	<i>Holocentrus adscensionis</i>
Mè-Balaou	Sailfish	<i>Istisphorus americanus</i>
Monbin	Squirrelfish	<i>Myripristis jacobus</i>
Moringue	Moray	<i>Gymnothorax moringa</i>
Mulet	Silver mullet	<i>Mugil curema</i>
Orphie	Needlefish	<i>Strongylura acus</i>
Orphie	Needlefish	<i>Tylosurus ardeola</i>
Orphie-Terre	Needlefish	<i>Tylosurus raphidoma</i>
Ouachalou or Tachalou	Parrot fish	<i>Pseudoscarrus guacamaica</i>
Pagre	Hamlet	<i>Hypoplectrus camprurus</i>
Pantouffier	Shovelnose shark	<i>Sphyrna tudes</i>

*English common names and revision of scientific names by Luis Rene Rivas, Marine Laboratory, University of Miami.

Pisciette or Pisquette
 Poisson armé
 Portugais
 Portugais noir, croissants blancs
 Raie
 Rele
 Requin bleu
 Requin blanc
 Requin piche
 Requin gris clair
 Requin noiratre
 Rondeau or Haut-dos
 Sade ordinaire
 Sarde dent chion
 Sarde grise
 Sarde a plume
 Sardine
 Sardine
 Sole
 Sole bouclée
 Sole grandes pectorales
 Sorbe
 Souris
 Tazar
 Thon (gros)
 Titiri: Larve d'un gobiide
 Ti-zieu
 Vareux or Varé
 Vermeille
 Vieille
 Vieille
 Vieille marbree
 Vieille noiratre marbree
 Vive
 Volant

Anchovy
 Porcupine-fish
 Queen angelfish
 Black angelfish
 Ray
 Wahoo
 Blue shark
 Lemon shark
 Mako shark
 Shark
 Shark
 Yellowtail
 Schoolmaster
 Bermuda chub
 Porgy
 Sardine
 Loose scaled sardine
 Hogchocker
 Flounder
 Mahogany snapper
 Red goatfish
 Kingfish
 Bluefin tuna
 Broadbill swordfish
 Silk snapper
 Grouper
 Catalufa
 Grouper
 Scamp
 Sand eel
 Flying fish

Stolephorus per fasciatus
Diodon hystrix
Angelichthys ciliaris
Pomachantus arcuatus
Dasyatis sabina
Acanthocybium solandri
Prionace glauca
Hypoprien brevirostris
Isurus oxyrinchus
Carcharhinus lamiella
Carcharhinus limbatus
Archosargus unimaculatus
Ocyurus chrysurus
Lutjanus apodus
Kyphosus sp.
Calamus proridens
Harengula clupeiola
Harengula humeralis
Achirus lineatus
Bothus luhatus
Bothus maculifer
Lutjanus mahogani
Upeneus maculatus
Scomberomorus cavalla
Thunnus thynnus
Sycidium sp.
Rhomboplites aurorubens
Xiphias gladius
Lutjanus vivanus
Epinephelus mystacinus
Priacanthus cruentatus
Mycteroperca bonaci
Mycteroperca falcata
Malacanthus plumieri
Excoetus rufipinnis

SUMMARY OF SESSIONS

FRIDAY—NOVEMBER 18.

Chairman—ROBERT H. WILLIAMS, Assistant Director, Marine Laboratory, University of Miami, Coral Gables, Florida.

Recommendations for the Protection and Rational Exploitation of the Sea Turtles

F. G. WALTON SMITH, *Director*
Marine Laboratory, University of Miami

A DISCUSSION on the above subject was scheduled at the request of the Caribbean Commission and of certain West Indian governments. Unfortunately there were in attendance only a small number of fishery scientists or administrators well acquainted with the problem.

Questions raised during the discussion included problems common to all fisheries in the region. It was clear that more careful and detailed collection of statistics is necessary in order to give an accurate evaluation of trends within the industry and of the condition of the turtle populations themselves. The limited statistics available suggest that the condition of the population varies considerably from place to place. In some places the average size of the turtles caught indicates no serious overfishing, whereas in a few localities the dwindling size suggests that the adult population is being depleted.

More often it appears that, although there has been no serious drop in average size, there has nevertheless occurred a decided drop in numbers. In the absence of catch-per-unit-effort data this is difficult to estimate accurately. The reduction in numbers is sufficiently obvious, however, to suggest that the breeding potential has dropped in many areas which were previously more productive but which have not suffered a marked decrease in average size. The causes of this appear to lie in interference with the nesting female, the eggs, or the newly hatched turtles. The interference may be by direct capture of turtles at this period of the life history or it may be the result of the invasion of the breeding beaches by the activities of mankind which tend to prevent their use by nesting turtles.

It was concluded, therefore, that regulation of the industry should aim at rigid prohibition of taking eggs or of catching turtles upon the beaches at any time of the year.

Next in order of importance from a conservation viewpoint is the enforcement of a size limit. Since it is effective both in maintaining the breeding potential and also in preventing overfishing, the minimum size regulation is a valuable safeguard. A size of at least 75 lbs. for the Green Turtle and 25 lbs. for the Hawksbill Turtle is recommended as the minimum size limit. Further investigation is needed to determine the size at which sexual maturity is attained and this will modify ideas as to the desirable size limits.

Protection of turtles during the breeding season is not, in itself, of any direct

value in conservation. Its value lies in giving female turtles extra protection during a vulnerable period of their lives. It is far more important, however, to safeguard the eggs and to prevent damage to the hatchlings leaving the beaches. To the extent that a closed season cuts down the catch to a desirable optimum it is useful. It would be economically sounder and better conservation practice to allow capture of suitably sized adults at the time and place when they are most easily captured, while protecting the stocks by setting a maximum catch limit in each locality, and while protecting recruitment by rigid enforcement of the egg-taking prohibition.

Interference with the breeding potential by egg taking and capture of nesting females is probably the most serious cause of decline in production. It is equally probable that increasing the breeding potential by care of the breeding females and hatchlings would lead to an increase in production. The amount of increased production would not necessarily justify these measures economically, and any proposal for turtle cultivation or farming should be carefully investigated from the viewpoint of financial cost compared with the probable increased production.

The problem of whether to raise adults in captivity for breeding purposes or to concentrate upon care of the offspring from natural nesting is a purely local one which should be decided by a competent local fisheries officer, in consultation with experienced fishery biologists. It is also advisable to set up a central experimental scale turtle farm and hatchery in the most suitable locality in order that information from this may be distributed to the separate areas interested. This is preferable to the setting up of a Caribbean-wide project.

In setting up regulations for closed seasons and minimum size it is important to have accurate scientific data regarding growth rate, age of maturity and duration of breeding season. This and equally desirable information regarding suitable sites for breeding or cultivation should be sought by the local fishery officers where they exist. Information, now lacking in many places, as to the average weight, numbers produced and similar statistics, is very valuable in judging the trend of the industry, the possibility of over-fishing and the presence and extent of a decline. Every effort should be made to collect such data and to make it available at least in mimeographed form.

As an aid to enforcement it is highly desirable that regulations throughout the Caribbean be as uniform as possible.

The enforcement of regulations and the collection of information is greatly aided by educational activities which enlist the interest, understanding and sympathy of the fishermen. A brief, well illustrated and simply worded pamphlet, distributed through local officials, school teachers, Justices of the Peace, and constables, could bring about a considerable change in the attitude of the fishermen and go far towards enlisting their support in protection of the industry as well as their aid in collecting information.

Those engaged in the marketing of turtles point out that, except in the case of purely local sales, there is increasing difficulty in selling turtle meat. Modern distributing systems rely very much upon large volume sales, particularly in canned goods, and cannot handle effectively the comparatively small volume of turtle meat available. The relative decline of small volume luxury trades has actually diminished demand for turtles to the extent that in the Cayman Islands it is claimed that a greater volume of turtle meat can now be produced than the demand calls for.

From an economic viewpoint it would seem more desirable to encourage domestic consumption and inter-island trade rather than attempt to revive a

luxury or semi-luxury trade with the United States or Great Britain, particularly in view of the present considerable imports of protein food into the Caribbean area. Where the demand exists, however, its satisfaction provides undeniable dollar credits. It would also seem advisable to encourage in every way possible the domestic manufacture of costume jewelry and ornaments and the decoration of toilet accessories with turtle-shell, rather than shipping the raw shell; thus retaining a larger share of the revenue for the country of origin. This should appeal to foreign importers because of the lower cost of handicraft labor.

Potentialities of the Caribbean Fisheries and Recommendations for their Realization

CLARENCE P. IDYLL, *Marine Laboratory, University of Miami*

R. T. WHITELEATHER, *Branch of Commercial Fisheries,
U.S. Fish and Wildlife Service*

AND

GERALD V. HOWARD, *Food and Agriculture Organization of the United Nations*

THE FISHERIES RESOURCES of the Caribbean region are capable of being exploited to a greater extent. Larger landings can be made by opening new grounds, making a greater range of species available to the consumer, and taking better advantage of seasonal abundances of certain migratory species.

For the island areas of the Caribbean, such as the West Indies, where local fish production is below the level of demand, the problem of increasing the supply falls into two parts, those of production and distribution. In the Central American states, the problem of absorbing larger catches involves the creation of a demand for fish. Attention is focused on the problems of production and distribution in the areas which are in need of increased landings.

In areas where the level of production is too low to satisfy consumer demand, certain methods may be applied to increase production. The most practical way is the moderate improvement of existing fishing gear and methods, together with the gradual introduction of motors for the present fishing craft. The introduction of complex mechanized gear from other regions is not practical in most cases, but the use of simple inexpensive gears from other regions should increase production in many instances. Examples of such gears are the unjang,* used in conjunction with a seine, the tuck seine, trammel nets, lampara nets, various trolling lures, and long lines.

Before new fishing methods can be introduced and present gear improved, arrangements will have to be made to instruct the fishermen in the use of such gear. It is suggested that local fishermen should be employed by the governments as fishery officers to teach their fellows in the use of these improved methods. In each region there are fishermen whose level of industry and intelligence is sufficiently high that they would be suitable as instructors.

It is particularly desirable that local men with an intimate knowledge of the language and customs be employed for instruction work, rather than outside "experts" whose influence is transient. It is considered that the success of such a scheme of education depends largely on what might be termed "follow-up." Many schemes for increasing fisheries production in the Caribbean region have started with promise but have ultimately failed because native fishermen have

*An anchored clump of coconut leaves marked by a float, which serves to attract fish.

been allowed to drift back to their traditional and relatively inefficient methods when the "expert" who instructed them has left. Simple difficulties in handling of new or improved gear arise which could be solved immediately by those familiar with the gear but which often prove insurmountable to the local fishermen. A permanent adviser is necessary to act as trouble shooter and to travel between the fishing areas to keep alive the initial enthusiasm for the new methods. It is this follow-up which is considered to be the key to the success of such ventures.

The training of local fishery officers to carry on this instruction work is the first problem. There are two agencies who might assist in organizing and obtaining personnel to set up such training programs, the Caribbean Commission and the Food and Agriculture Organization of the United Nations (FAO). It is suggested that the governments concerned should approach these organizations, requesting such assistance.

With respect to the training requirements, these programs do not appear to require large amounts of money, and the individual governments concerned should not have difficulty in financing them. The international organizations suggested could assist in obtaining trained personnel to instruct the selected native fishermen to be trained as fishery officers and in organizing training centers in the region or in an outside country.

An additional recommendation toward increasing production is that the governments should be prepared to grant loans or credits to individual fishermen or groups to finance the purchase of gear and equipment. The introduction of better craft and gear involves an outlay of capital beyond the means of most ordinary fishermen, and some assistance in this connection appears necessary.

In order to absorb larger catches, even in the areas where there is a demand for increased amounts of fish, there are problems associated with marketing and distribution which must be solved. The greatest difficulty is encountered in getting fishery products to the consumer in a condition suitable for consumption and at a price that he can afford to pay. This is particularly true for inland communities. In addition, at times of seasonal abundances of certain species, it is often impossible to dispose of the increased catches.

Landing centers are required which are provided with wharves, sanitary markets and moderate storage facilities. Government assistance is needed to secure these.

In order to facilitate distribution, simple and inexpensive methods of preservation are required. Traditionally, the people of the island areas of the Caribbean have consumed large quantities of imported salted fish. The existing demand for saltfish products, and the simplicity and inexpensive nature of preserving fish by salting, suggests this method should be more widely employed. Technological research has shown methods which can be employed for cheap and easy production of good saltfish products. Many local species such as sharks, sardines and jewfish are suitable for salting. With proper handling, these products could replace, or at least supplement, salt cod which is now imported at great cost.

The problem is to instruct the people in the practice of suitable methods of salting fish. Again, it is suggested that local men especially trained for this purpose be employed to train others. Once more, a continuous follow-up is emphasized for the success of such a project, since experience has shown that new methods will be abandoned if continuous assistance and encouragement is not provided.

As local men will first have to be trained in salting practices before they

are able to instruct their fellows, it is again suggested that the governments request the assistance of the Food and Agriculture Organization or the Caribbean Commission in establishing the initial training programs. These organizations could probably secure or provide the initial personnel to put such projects into effect. The training of the fisheries officers should preferably take place in the Caribbean area itself.

Other preservation methods, such as smoking and drying, should be given consideration. Freezing has also been suggested, but it is not considered practical at the present time as most Caribbean countries are not capable of supplying the capital necessary for elaborate refrigeration plants. However, additional ice making plants should be constructed in order that ice may be more widely used, both in the storage and transportation of fish.

Since the main fisheries problems involve the training of practical fishermen and fishery technologists, it is suggested that biological research should be limited, for the present, to the collection of catch statistics to evaluate productivity and to detect trends of abundance. Formal fishery research involving studies of life histories and ecological relationships, as well as the exploration and development of offshore fisheries for tuna and other pelagic species, might best be entrusted to international organizations or private institutes or laboratories who could undertake to do this type of work for all the countries jointly. It is not felt that the fisheries resources justify individual governments each conducting such work. Once again, such organizations as FAO and the Caribbean Commission or competently staffed private laboratories are indicated as agencies best able to initiate and coordinate such programs. The governments concerned should consider approaching such organizations for assistance.

In summary, it is suggested that the development of the fisheries resources of the Caribbean can best be accomplished by simple and practical methods which involve the use of local people trained for the purpose, rather than foreign experts whose influence is transient. The importance of follow-up in all phases is emphasized as being essential to success. Government support is necessary to provide capital both for loans to individual fishermen or groups to finance the purchase of gear and equipment, and for the payment of specialists to train local fishery officers in the initial phases.

The original technical assistance might be provided by the Food and Agriculture Organization, the Caribbean Commission, or through cooperative agreements between governments concerned in the Caribbean region.

Potentialities of the Gulf of Mexico Fisheries and Recommendations for their Realization

J. L. BAUGHMAN

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THE FISHERIES of the Gulf of Mexico fall into two classes, the littoral or shore fisheries, generally carried on in the territorial waters of the various states, and the offshore fishery, most of which is in international waters.

The most important species of the littoral zone and their relative poundage for the last year of complete record (1945) are shown in Table 1.

TABLE 1

SPECIES	FLORIDA	ALABAMA	MISSISSIPPI	LOUISIANA	TEXAS
Menhaden	121,911,600		57,340,000		
Mullet	34,527,900	3,335,900	156,400	76,500	94,600
Spanish Mackerel	10,638,000	69,500	7,200	1,700	14,300
Trout	4,376,400	369,000	102,300	638,000	1,169,900
Redfish,					
Red Drum or Channel Bass	2,052,700	260,000	66,300	596,300	1,296,200
King Mackerel or Kingfish	3,897,300				22,100
King Whiting or Whiting	1,761,000	192,900	190,700	499,700	120,200
Black Drum	986,400	141,200	19,800	300,500	1,213,300
Blue Runner	1,981,700	1,500			
Bluefish	1,831,100	31,300	500		
Flounder	751,000	216,900	167,700	220,800	135,000
Pompano	766,400	4,500		500	3,700
Snook or Pike	512,200				1,200
Sharks	2,028,400			27,400	64,000
Blue Crabs	6,485,600	2,207,400	5,638,600	33,649,600	339,200
Sponges	266,000				
Other Littoral Species*	8,010,900	521,500	201,900	1,057,400	110,500
TOTAL	212,780,500	7,351,700	63,891,400	37,068,400	5,164,200

*Excludes shrimp and oysters.

Their value, in order of their monetary importance, is shown in Table 2.

TABLE 2

SPECIES	FLORIDA	ALABAMA	MISSISSIPPI	LOUISIANA	TEXAS
Mullet	\$3,842,974	\$400,428	\$ 18,768	\$9,180	\$9,460
Sponges	3,003,897				
Blue Crabs	190,010	110,370	282,030	2,124,516	39,141
Trout	839,750	88,728	24,342	204,416	368,898
Spanish Mackerel	1,363,847	13,900	1,440	238	2,455
Menhaden	770,841		425,176		
Redfish or Red Drum	249,652	62,294	15,912	143,112	233,432
King Mackerel or Kingfish	575,098				2,967
Pompano	334,094	2,340		250	1,480
Bluefish	306,231	6,260	125		
Black drum	64,558	16,944	2,376	36,060	132,151
Flounders	100,491	43,380	32,940	46,369	26,188
Whiting or King Whiting	61,397	22,428	22,884	59,409	13,220
Blue Runner	119,491	210			
Snook or Pike	63,612				180
Sharks	32,214			2,740	2,540
Other Littoral Species*	1,282,160	39,371	3,512	127,085	20,190
TOTAL	\$12,899,277	\$724,313	\$829,505	\$2,753,125	\$849,822

* Excludes shrimp and oysters.

In any survey of the potentialities of the Gulf, it seems well to consider first those fisheries which offer definite possibilities of expansion, under a program of research to determine their needs and the best methods of managing them. The following are worthy of attention:

Mullet production in Florida, due to overfishing and the ravages of the Red Tide, has declined during the past two or three years to the point where hardship is being worked on the fishermen. However, effective and continued research to determine correct management practices and, once these have been worked out, proper legislation to conserve the stock, should go far towards re-establishing the fishery at its former level, particularly as the ravages of the Red Tide are naturally replenished.

To the westward, Alabama production can be somewhat increased by the same means, but it is to Louisiana and Texas that we should look for any large increase in the catch. Although the mullet in these areas are smaller ($\frac{3}{4}$ to 1 pound on an average) than those in Florida, there is a rather large population in both states that could well be utilized, particularly if markets for the species could be developed in the midwest.

Next to mullet, the most valuable littoral fishery of the Gulf coast is the *sponge* fishery of southern Florida. At the present time this is badly depleted and threatened with extinction, due to the inroads of the sponge disease and to overfishing.

To re-establish this fishery, the size limit on wool sponges should be increased and strictly enforced, accurate production records kept so that the trend of the fishery can be followed closely, and mature sheepswool sponges planted north of the Tortugas region on suitable reefs. Oceanic currents from that area would carry the drifting sponge larvae from here to the deep reefs off the west coast of Florida and it is felt that the economic possibilities of doing this on a large scale should be thoroughly investigated. Exploration for new grounds should also be carried on, and may help, but it is probable that the future of the industry will depend on two things. These are research on (and management of) our present reefs, to give the sponges that are left a chance to re-establish themselves, and development of sponge culture on the extensive, suitable bottoms throughout the Florida Keys and about Tarpon Springs.¹

Trout, *redfish* and *drum* are grouped as they are similar in their requirements and habitats. All three species have been seriously depleted. Littoral species, dependent on the bays during the early part of their existence, they are particularly vulnerable to the inroads of civilization. Destruction of habitat and overfishing are the main causes of the depletion. However, research on their ecology and good management should, over a period of time, increase the annual catch.

The fishery for *blue crabs* is (exclusive of shrimp and oysters) the fourth largest on the Gulf coast. Nevertheless, it could be increased materially. Texas, for instance, produces almost no crabs, although possessing a large crab population.

Research to establish the ecology of the species along the Gulf (which is considerably different from the Chesapeake Bay area where the same crab is caught), and exploratory work to determine the presence or absence of crab populations, inshore or offshore, at all seasons of the year, should make it possible to expand this fishery considerably.

Almost the total production of *Spanish mackerel* is in the Florida area, a fact which would point to potential increases in the catch if the large population of this species in the western Gulf could be utilized.

Exploration to determine the extent of this population, biological data on which to base management practices, and the devising of fishing gear to meet conditions off the Texas and Louisiana coasts, are all necessary, however, before the fishery will be able to undergo any considerable expansion.

Although the tables given above show no *menhaden* fishery in Alabama, Louisiana or Texas, since they were compiled plants have been established at Cameron, Louisiana and Port Arthur, Texas, boats supplying both plants fishing in Louisiana waters. The fishery is capable of further expansion in the Gulf of Mexico, although, because of local prejudices, it will take much educational

1. Tierney, J. Q.—1949—*The sponge industry of Florida*. Fla. State Bd. Conser., Educational Series, 2:1-20.

work, based on research, to convince some segments of our population that the fishery is desirable and that it offers no threat to the fishery for the sciaenids.

Further exploration is needed to determine the extent of the far ranging schools, and much biological work to determine the life history and ecology of the species. With this and with wise management it should be an invaluable resource of the area.

Kingfish, which at times occur in great numbers along the Texas coasts, are little utilized anywhere but in Florida. This may be accounted for by the fact that the muddy waters of the Texas and Louisiana littoral force the schools far out to sea. So little is known about the species that it is difficult to evaluate its potentialities.

Exploration of the possibilities of the fishery, development of biological knowledge of the fish, and designing of adequate gear for its capture in numbers, are all necessary before any very large development can be expected.

In this connection, it is pertinent to suggest that the Japanese long-line, as used in the Pacific, might be an excellent method for catching both kingfish and Spanish mackerel in the western Gulf, where conditions (unlike those of Florida) make the use of nets extremely difficult.

The chief production of *pompano* is in the eastern Gulf. This seems strange, for, during the early summer, large numbers of young are present in the surf almost anywhere along the coasts of the western Gulf, it being by far the most common species in any haul of a minnow seine made at this time. These young fish range from $\frac{1}{2}$ to 6 inches in length. Either there is an almost 99 per cent mortality among the youngsters, which does not seem probable, or else, somewhere in our waters, there is a population of this species that we have not discovered and do not know how to catch.

Although *bluefish* were once caught commercially off Galveston, apparently there are few of them in the Gulf, and the fishery offers little or no chance for expansion.

The majority of the *flounders* occurring in the commercial catch are of the genus *Paralichthys*, generally found close inshore, and particularly in the bays. As far as the species comprising this genus goes, there appears little chance for expansion of the fishery, although more extended knowledge of their life history and ecology might make this possible.

However, other genera of the same family, notably those of the genus *Cyclopsetta*, are rather plentiful on the continental shelf. During the operation of the U. S. Bureau of Fisheries Ship "Pelican," they were caught throughout the area worked. While not as well liked for food as the paralicthyids, one of these, the sand dab or window pane, as it is known colloquially, is frequently marketed by the shrimp fishermen.

Exploration of the continental shelf of the Gulf, with proper trawling gear, should produce some very interesting results, possibly leading to the establishment of a deep water trawl fishery for flounders and other flatfish.

The fisheries for *king whiting*, *blue runner* and *snook* may be capable of some expansion in the Gulf, but it is doubtful whether it would be significant.

At present there is a well developed *shark* fishery in the Gulf, as far west as the mouth of the Mississippi. Recent research by the Marine Laboratory of the Texas Game, Fish and Oyster Commission is helping extend this south and west to Port Isabel.

Species in the fishery belong mostly to the genera *Galeocerdo*, *Sphryna* and *Carcharhinus*. So far these Gulf sharks have been utilized mostly on the basis of their fins and liver. The fins go to the Chinese market and the liver is used for

the production of vitamin A oils to fortify chicken and stock foods, the vitamin A potency, in all but a few individuals, being too low for pharmaceutical use.

On this basis, the average value of a shark is about \$5.34. However, during the experimental fishery, arrangements were worked out to use the hides, teeth and carcasses, thus raising the average value to about \$10 per fish. Such careful attention to the by-products of this fishery may make it more profitable, if labor costs are not too great.

Another interesting possibility lies in the development, through exploration, of new shark grounds at the edge of the continental shelf. Livers from this area may run much higher in vitamin potency and thus form the basis of a more valuable fishery.

Othe littoral species include *amberjack*, *barracuda*, *crevalle*, *croaker*, *grunts*, *jewfish*, *muttonfish*, *pigfish*, *pinfish*, *sea bass*, *sea catfish*, *mangrove snappers*, *white trout* (*Cynoscion arenarius* and *C. nothus*), *tripletail*, *conchs*, *bay scallops*, *clams*, and *spiny lobsters*.

Several of these are capable of producing greater catches than at present. Sea catfish, if a market were developed for them, are very plentiful, as are the two species of white trout. None of these is taken to any great extent.

While the Florida fishery for spiny lobsters has declined in recent years, it could be re-established at somewhere near its former level by proper management. It is also probable that exploration may even disclose new grounds, as the topography of the Gulf bottom becomes more familiar. One specimen of this crustacean has recently been taken off the Texas coast, where the species was not known to occur.

Among shellfish other than oysters, which may repay investigation, there are considerable stocks of *clams* at various localities along the Gulf coast and there are some indications that there may be beds of deep-sea *scallops*.

THE OFFSHORE FISHERIES

So far we have discussed only the littoral fisheries, the majority of which are carried on close to shore, with comparatively small boats. In so doing, we have entirely neglected two of the most important fisheries in the Gulf, namely, the shrimp fishery, which far overshadows all the rest combined, and the fishery for red snapper and grouper, which ranks second among the fin fisheries.

Production for 1945 (the last year for which complete figures are available) of these fisheries, in pounds, is shown in Table 3.

TABLE 3

SPECIES	FLORIDA	ALABAMA	MISSISSIPPI	LOUISIANA	TEXAS
Shrimp	13,661,900	4,439,300	6,594,900	116,904,200	15,721,000
Groupers	8,593,400	168,600	7,300	3,000	17,200
Redsnapper	3,092,100	1,360,500	12,000	25,500	288,200
TOTALS	25,347,400	5,968,400	6,614,200	116,932,700	16,006,400

The dollar values are shown in Table 4.

TABLE 4

SPECIES	FLORIDA	ALABAMA	MISSISSIPPI	LOUISIANA	TEXAS
Shrimp	\$1,877,012	\$488,323	\$735,247	\$13,894,223	\$1,973,626
Groupers	998,947	23,604	1,094	480	2,234
Snapper	613,844	340,125	3,000	6,375	47,094
TOTALS	\$3,489,803	\$952,052	\$739,341	\$13,901,078	\$2,022,954

Prior to 1938, there was only a small offshore fishery for *shrimp*. Since that time, however, it has grown steadily. Larger boats, better gear, radios and Diesel engines have all contributed to this, until today approximately 8,000 boats of all sizes and types ply the waters of the bays and Gulf.

The great increase in the number of shrimp boats, along with a much greater increase in unit effort (it takes approximately 10 times the effort today (1949) than it did ten years ago to catch a pound of shrimp) make it imperative to develop, if possible, new fields for this fleet to work. The red, grooved, or "Golden Brazilian" shrimp may be the answer to this.

Until 1948, the white shrimp, *Penaeus setiferus*, formed 95 per cent of the total catch. Since then, the Brazilian or grooved shrimp, *Penaeus aztecus* and *P. brasiliensis*, and the sea bob have formed an increasingly large proportion of the production, until today (1949) in Texas, *P. aztecus* probably composes 50 per cent of the entire fishery.

Long familiar with the white shrimp, it was difficult for Gulf fishermen to adjust themselves to the different habits of the Brazilians, and to change their methods to produce an adequate catch.

Little is known about these species compared to the white shrimp and it will be necessary to explore and find new grounds where red shrimp can be caught if the fishery is to continue to expand. Otherwise, it is in for a serious setback. Fishing pressure is becoming exceedingly heavy and the fishery for *Penaeus setiferus*, or white shrimp, has already begun to show the effects of it.

The fishery for *red snapper* and *grouper* is at present in somewhat better condition than the figures given would indicate. Texas production alone has increased nearly 800,000 pounds over 1945, and probably there has been an attendant increase in Alabama and Florida, although 1949 figures for these states are not available.

Beginning as a littoral or shore fishery, when the nearer fishing grounds were exhausted, the boats extended their trips farther and farther to sea. Today boats from Pensacola, Mobile, Galveston and Port Isabel regularly make the trip to the Campeche Banks, off Yucatan, and it is from here the greater portion of our production comes. Nevertheless, there are indications that it may be possible, by exploration and biological research, to develop new fisheries closer to home.

From our present knowledge, which is extremely fragmentary, it seems that the snapper migrate not parallel to the coast, but vertically to it, and if this be true, then offshore, perhaps over the 100 fathom line, there may be large concentrations of snapper and grouper that will support a fishery. One of the main objections to this theory so far has been that the general bottom terrain of the northern Gulf, so far as was known, was not of the sort snapper and grouper preferred as a habitat. This plain, as far as we knew, had few coral reefs, gullies, or other topographical features of the sort found where snapper are usually caught.

This is incorrect. J. Ben Carsey, Chief Geologist of the Humble Oil and Refining Company, in a recent paper, calls attention to the fact that there are at least 164 topographical features occurring along the edge of the continental shelf of the Gulf.² Mr. Carsey's findings extend no farther eastward than Grand Isle, Louisiana. However, it is not at all improbable that similar topographical features and coral reefs are present in the eastern Gulf, all of them presenting what

2. To give an example: A restricted area, 90 miles south of Galveston, near 28° latitude and 94°30' longitude shows, upon contouring, two clusters of topographic features which have a relief of from 200-300 feet above the ocean floor, in 60 fathoms or less.

may prove to be an exceedingly profitable field of fisheries exploration for such fishes as red snapper and grouper.

While on this subject of the edge of the continental shelf, it might be well to explore another possibility. Less than two years ago a *tile fish* was taken on the Campeche Bank and, while "one swallow does not a summer make," nor a single fish a school, it is preposterous to believe that this one tile fish swam merrily down the sea from the New England coast (the only place from which it was previously reported) to the banks of Yucatan. It might be of some interest to note that Collins (Rept. U.S. Comm. Fish. 10:246) describes the habitat where it was originally found, over hard clay bottom, in deep water, where a warm water layer extends to the bottom.

Have we such a habitat in the Gulf of Mexico? Have we a tile fish fishery at our back door that some exploration will develop?

Another potential basis, for a new fishery in the Gulf of Mexico, is *tuna*.

Some years ago (Baughman, 1941, Trans. Tex. Acad. Sci. 1940:18) a number of tuna were caught which, upon identification, proved to be Lesson's Black-finned Tuna (*Parathunnus atlanticus*). Quoting from a letter from Stuart Adkins, of Port Isabel:

"Not many of them have been caught, for as a rule they run far offshore, well over the 100 fathom line. I have seen the Gulf covered with them. Some, I believe, would go over 200 pounds but there always are plenty of big sharks among them also. These fish are always headed southeast, or near that, and travelling plenty fast. We are not very familiar with their travels."

Early in 1948 a shrimper described a school of fish which he had seen far offshore, covering many acres. This may have been a school of tuna. In July of this same year, at Port Isabel, 4 more tuna were taken, and a few days later, a biologist, flying over the Gulf, slightly north of Tampico and about 200 miles offshore, saw a mile long school of mighty, fusiform fishes which he estimated at eight or ten feet in length. Again the word tuna suggested itself.

Lindner and others, in listing the fishes of the Caribbean, state that there are at least 4 species of tuna in that area, *Euthynus alleteratus*, *Thunnus thynnus*, *Neothunnus albacora*, and *N. allisoni*, as well as albacore, *Germo alalunga*, and 3 species of bonito. They state:

"Open surface offshore areas are the least known of the Caribbean habitats" [and, interpolating, of the Gulf of Mexico]. "The offshore-oceanic region is perhaps the least productive of food-organisms, for the supply of nutrient salts is low. Yet all available evidence points to considerable supplies of fish in the "blue" waters. The fish in this habitat may be divided into two groups—the long-range migratory such as tunas, sword fish, marlins and sailfish, and the limited migratory such as Spanish mackerel, kingfish, flying fish, and dolphins. The first group has been available to shore fishermen only at certain times of the year, but may be taken, possibly, in quantity offshore at other times. Hardly anything is known of the *distribution, abundance, migration routes, or seasonal occurrence of the pelagic fishes*. Since the abundance of these migratory fishes is not directly affected by the low productivity of the Caribbean Sea, there is some reason to believe that considerable amounts might be taken with proper methods. Limited migratory species are not now being utilized to the extent possible, and this is due chiefly to the limited radius of the present fishing methods.

"From all evidence available and after consideration of the other habitat types, it is suggested that the fisheries for the pelagic species, both inshore and

offshore, offer the greatest possibilities for fishing expansion in the Caribbean area."

The conclusion stated above probably holds true for the Gulf of Mexico also.

An interesting possibility that might be developed by a fisheries survey is connected with the Pacific tuna fishery. Whether or not a Gulf and Caribbean tuna fishery can be developed remains to be seen, but, the fact is, there are tuna within fishing distance of Gulf ports, for the tuna fishing grounds of the Pacific are many hundreds of miles closer to Houston and New Orleans than they are to the Californian ports from which the tuna clippers now operate. Live bait, on the west coast, is, as a rule, obtainable only in Mexican waters, and for years the Mexican government has levied exorbitant taxes on such bait. A supply in Gulf and Caribbean waters would make it possible for boats operating from the Gulf to travel to the Pacific grounds without payment of these prohibitive taxes, thus possibly giving badly needed room for expansion to our Gulf fishermen. Moreover, no such fishery could operate in either the Gulf or Caribbean unless they were certain of sufficient bait (Baughman, 1949, Proc. Gulf and Carib. Fish. Inst. 1:15-19).

Chilton, in 1949 (So. Fisherman 9 (10):48-49, 154), gives an extensive account of occurrences of the "little tuna" (*Euthynnus alleteratus*) along the Atlantic and Gulf coasts and in the Caribbean sea.

"Further exploration and development of this resource present possibilities of opening up a new industry. An investigation, both from a biological and commercial standpoint, seems justified."

We cannot overlook, either, the possibilities of the so-called deep scattering layer, which has been so much in the minds of oceanographers and biologists since the rapid development of sonic depth-finding equipment. While it now seems to be generally agreed that tropical and sub-tropical waters produce, in the aggregate, as much plankton over the course of a year as do more northern waters, there are apparently no such concentrations at any one time in the equatorial belt as are found in more boreal sections. Hence (so far as we know), no concentrations of fish occur similar to the cod and herring fisheries of the north Atlantic.

Other possibilities for development of the Gulf fisheries are plentiful, especially in the line of fisheries by-products.

We should not neglect the importance of *seaweeds* in any discussion of the Gulf. It has been known for a long time that some of these are excellent sources of potash and iodine. Another product is agar, used in microbiology, pharmacy, medicine, dentistry, photography and food manufacture. It occurs in red sea weeds such as those known as *Gelidium* and *Gracilaria* (Tarr, op. cit.). At least nine species of these appear on the Gulf Coast (Taylor, 1941, Mich. Acad. Sci. Arts Letters 26:69-79).

Another development in the seaweed field is the production of rayon-like fibers from certain metallic alginates (Speakman, *Nature* 155:655). Similar fibers have been produced from collagen, a by-product of fishes (Highberger and Kirstin, U.S. Patent 2,374,301). Alginic acid is present in *Sargassum*.

SUMMARY

The fisheries of the Gulf of Mexico present many potentialities for development. Among the littoral fisheries the ones holding the most promise are those for mullet, sponges, blue crabs, the Sciaenids, Spanish mackerel, King mackerel, pompano, flounders, menhaden, sea catfish, white trout, clams, and spiny lobsters. In all these, biological research, on which to base wise management

practices, is a prime necessity, along with legislation adequate to the needs of the particular fishery in question.

Offshore, the shrimp fishery, particularly that for the "golden Brazilian," or red shrimp, will probably stand considerable expansion, but needs exploration to develop new grounds.

Possibilities are present for the expansion of the red snapper and grouper fishery, and there are indications that two or three of the tunas, not now entering the commercial catch, may be present in sufficient quantity to support a fishery. Tile fish have also been found in the Gulf area.

Bearing these things in mind, the continental shelf should be thoroughly explored, with the following objectives:

- (1) Development of new shrimping grounds.
- (2) Development of new red snapper and grouper fisheries.
- (3) Development of new sponge grounds.
- (4) Location and development of a flatfish fishery.
- (5) Development of a shark fishery along the hundred fathom curve.
- (6) Location of tile fish in commercial quantities.
- (7) Location of deep sea scallop beds.
- (8) Location of tunas and determination of their abundance.
- (9) Investigation of the presence or absence of the "deep scattering layer," and its possible effect on fish.

A fertile field for development is presented in utilization of the by-products of the Gulf fisheries, and it is suggested that the seaweeds of the area may be plentiful enough to be utilized for various purposes.

Potentialities of the Gulf Oyster Industry and Recommendations for their Realization

J. L. BAUGHMAN, *Chief Marine Biologist*
Texas Game, Fish and Oyster Commission

THE POTENTIALITIES of the Gulf coast for the production of oysters are apparently enormous, yet Dr. Radcliffe found in a recent survey that out of an estimated 916,000 acres of bottom available for culture, only 25,600 acres (*or less than 3 per cent*) are under lease. The balance of our steadily declining production comes from public reefs.

As an actual matter of fact, only one state on the Gulf coast has any appreciable production of cultivated oysters. That is Louisiana.

Within recent years there has been a good deal of research on the possibilities of the coast, and upon optimum habitats for the oyster of the area. More is needed, particularly on the time of spat fall, the best season to transplant oysters, the proper times to spread cultch, and *a thorough survey is needed of all bottoms to determine where it is possible to grow oysters with a reasonable degree of economic success.*

These things should be part of any state plan of research to protect the people engaging in such culture and to aid them in so far as is possible, to utilize their bottoms to the best possible advantage.

Research is also needed as to the best and most economical methods of improving bottoms not now fit for oyster production so that they can be used for this purpose.

There is widespread agreement with the statement made by Dr. Radcliffe that

in general the future development of the oyster industry in the South is not so much dependent upon the development of new scientific knowledge of what to do, as it is upon political and legal considerations and the practical application of knowledge now available.

It must be remembered that the laws of the Gulf coast states in regard to oysters are often such that they accomplish a diametrically opposite result from the one ostensibly intended. Nearly all of them are based on the old and erroneous concepts of public reefs, kept up by the state, for the benefit of everyone, Louisiana being a notable exception.

It has been repeatedly proven that this concept is fallacious. From the experiences of Maryland and other states, it has been learned that the cost of such a program is so great that it is impossible satisfactorily to maintain public grounds either by subsidy or by direct tax, and that it would be cheaper in the long run to give the money directly to the fishermen as a reward for not producing oysters. The end result would be about the same.

It has also been repeatedly proven that *oyster culture is successful only when the oyster producers have an actual financial interest in the beds which causes them to care for them just as they would for a piece of farmland that they owned*. Common sense and the dictates of the producer's pocketbook will make him care for such beds as he would never care for public reefs.

Any large expansion of the oyster industry on the Gulf coast is dependent mainly upon two things. These are laws designed to encourage the leasing of grounds for private use, and the enlistment of outside capital, from oyster growing areas, to develop these grounds.

It is wishful thinking to believe that, in the present state of economy, much support for such a program is going to come from the Gulf coast itself. Our fishing fleets operate on one fishery almost exclusively. *As long as shrimp are running the boats are going to fish for them. When they are not, the boats will stay tied to the docks waiting for them to run and will not engage in anything as hard and time consuming as oyster culture for fear that they will miss the shrimp.*

A fact that many people overlook in their consideration of oyster culture on this coast is that the Louisiana beds were started in the years before the shrimp fishery attained anything like its present proportions. Moreover, in the beginning, it had a hard core of Czechs as its mainstay, who were accustomed to long hours, hard work and a reasonable return for their money. Today, the sons of these men are turning to shrimping (rather than oystering) as a means of livelihood.

It must be remembered, also, that it takes money to cultivate oysters. The same amount of money expended on a shrimp boat will produce for the individual quicker and easier returns, with comparatively longer periods of idleness, in which to enjoy living.

Economic Potentialities of the Gulf and Caribbean Fisheries and Recommendations for Economic Investigations Towards their Realization

R. A. KAHN, *Branch of Commercial Fisheries, U.S. Fish and Wildlife Service*

THE DISCUSSION of Dr. Larsen's paper on air transportation brought out interesting points on packaging methods, useful in these subtropical areas, and on the relationship of transportation costs to total costs of the higher valued fish, for example, red snapper, and shellfish (including Crustacea) of these areas.

The potentialities of increased spiny lobster production is mainly conditioned by application of better gear, by better grading service, by proper inspection methods, by price and production stabilization and by a possibly centralized sales organization. The paper on sponges discussed the bills before Congress, of which the session considered H. R. 6063, introduced by Congressman Peterson, identical with S. 2489, introduced by Senator Pepper, as the most important ones. In this bill, \$250,000 is being requested for the study of sponge diseases, study of sponge plantation and rehabilitation of the depleted sponge beds of Florida. The interest of Hon. Charles E. Bennett, Congressman from Florida who was present was especially appreciated. Congressman Bennett will advocate the inclusion of economic studies under this bill. The paper of Mr. Anderson on Texas fishery capital investment was a very valuable contribution to our knowledge on what capital is invested in the fishery. The session expressed the desire to have more such State studies available. A most stimulating discussion arose after Mr. Todd's paper on the social conditions of full time fishermen which emphasized the interest of fishermen in conservation. The discussion in which all parts of the industry, dealers, wholesalers, producers, as well as Congressman Bennett and various members of government agencies participated, closed with an appeal to the conservation agencies to use all their resources to make a constant fish supply available to those who rely on this supply for their livelihood. The discussion of labor conditions led to the discussion of cooperatives and the cooperative movement in the Caribbean and Gulf fisheries. There are potentialities in developing this movement side by side with the legitimate trade. The needs for fresh fish in the domestic market in these areas are great. Potentialities to fill this need are existing. If the fishermen learn the "know how," if trade and retailing methods adapt themselves to the requirements of the public, an expansion of the existing production of fresh and frozen area fish to the double quantity compared to the one which exists today can be expected within a reasonably limited period.

The recommendations of the Economic Session are these:

1. To approach the Governments and peoples of the Gulf and Caribbean Area with the suggestion to develop the spiny lobster production and trade by furthering the introduction of proper catching methods, stabilization of prices, improvement of transportation, grading and inspection service, freezing and refrigeration service and by the establishment of proper sales organizations.
2. To approach the Governments and peoples of the Gulf and Caribbean Area with the suggestion of developing to a great extent air transportation for fish and fishery products including proper packaging methods for air transportation and proper subsidization of air transportation as far as it should be necessary.
3. To support H.R. 6063 introduced by Congressman Peterson and the identical S. 2489 introduced by Senator Pepper which are at present before

Congress for the purpose of studying the possibilities of the rehabilitation of Florida sponge production including the study of the economic conditions of the sponge market.

4. To approach the Governments and peoples of the Gulf and Caribbean area with the suggestion to make a survey of capital investments in the fisheries similar to what was done by the Texas Game, Fish and Oyster Commission for the State of Texas.

5. To approach the Governments and peoples of the Gulf and Caribbean area with the suggestion of developing natural fishery resources in the interest of increased income of fishermen and to exercise their taxing power to level off the competition between sports fishermen and commercial fishermen in local market areas.

A Coordinated Program of Marine Studies for the Gulf and Caribbean

LIONEL A. WALFORD, *Chief, Branch of Fishery Biology,
U.S. Fish and Wildlife Service*

IN THE BIOLOGICAL and oceanographic session, the possibilities of a coordinated program of marine studies for the Gulf and Caribbean were discussed.

The Chairman announced the passage in the last session of Congress of a bill transferring to the Fish and Wildlife Service two ocean going vessels, one to be used primarily for biological-oceanographic studies; the other for exploratory fishing. Congress also appropriated funds for operation of the vessels.

The discussion centered about the program to be carried out by the biological-oceanographic vessel. Funds available this year are sufficient to pay for its conversion and possibly for a short period of operation.

The Chairman proposed that all research and conservation agencies in the Gulf area having an interest in the program participate in it to the end, that all the facilities and talents available be brought together for a unified comprehensive study of the ecology of the Gulf.

It was brought out in the discussion that many institutions, including universities, conservation bureaus and private research institutions, are engaged in biological or oceanographic research in the Gulf.

The Chairman invited representatives of these agencies to participate with the Fish and Wildlife Service in the use of the new vessel and to assist in making a coordinated program at a meeting to be called later before the reconversion of the vessel is completed. Meanwhile, at the suggestion of Dr. Waldo Schmitt, it was agreed that a digest of existing literature on the biology and oceanography of the Gulf of Mexico should be made immediately. Dr. Paul Galtsoff of the Fish and Wildlife Service will act as organizer, manager and editor of this digest, which will be made cooperatively by all interested workers who will volunteer to contribute to the effort.

The Fish and Wildlife Service will prepare bibliographies for the participants when necessary; and when possible, will furnish stenographic help.

The questions in which the Fish and Wildlife Service is most interested in the new research program are these:

1. How are the various kinds of organisms associated in time, space, and abundance with each other, with the changing environment and with the activities of man?

2. What influences the distribution of the physical and chemical variables constituting the marine environment?

Closing Address

F. G. WALTON SMITH, *Chairman*

AFTER A heavy week of almost continuous discussion, it does not seem desirable to inflict a long and tedious speech upon the participants in this conference. It is, in fact, quite unnecessary to revue in detail the deliberations of the past few days, since this has already been done admirably by the session leaders in their summary reports during today's session. In closing the conference I will merely draw attention to the remarkable success that has attended the intermingling of economists and biologists, fishermen and administrators, in this attempt to integrate the efforts of so many widely scattered workers. The economic session in particular has produced a ferment of new interest and practical ideas. The Gulf fisheries session has laid the foundations for a well organized program of fisheries research with the closest possible integration between state and federal agencies. In looking forward to next year's meeting we can therefore, I think, feel that we are working along really productive lines and that our labors have not been fruitless.

There have been a few instances where I believe we may improve the organization of these meetings, and your executive committee has given careful thought to this. One deficiency perhaps has been the comparatively small participation of the fishermen and dealers. It is strongly urged that support from this section be sought in every state.

The publication of Proceedings has become a problem of expense which the sponsoring institution has had difficulty in facing. Fortunately this may be solved by suggestions from their officers that the Gulf and the Atlantic States Fisheries Commissions may be able to contribute financially.

It is not too early to look forward to next year's meeting and your committee asks that suggestions be made regarding the agenda as early as possible.

In conclusion may I be allowed to congratulate all participants upon the valuable results which have arisen from their common efforts.

Appendix

1947 POPULATION OF THE TERRITORIES IN THE GULF AND CARIBBEAN AREA

COMPILED BY RICHARD A. KAHN

Branch of Commercial Fisheries, U.S. Fish and Wildlife Service

<i>Independent Territories*</i>	<i>Population</i> MILLION	<i>Dependent Territories**</i>	<i>Population</i> MILLION
Honduras	1.1	Bahamas	.075
Venezuela	3.4	Barbados	.199
Costa Rica	.6	Br. Guiana	.391
Colombia	9.0	Br. Honduras	.059
Nicaragua	.9	Curacao	.149
Panama	.6	French Guiana	.0231
Mexico	15.1	Guadeloupe	.2791
Guatemala	3.2	Jamaica	1.327
El Salvador	1.6	Leeward Islands:	
Dominican Republic	1.5	Antigua	.043
Haiti	3.0	British Virgin Islands	.006
		Montserrat	.013
Total Independent Territories	40.0	St. Kitts—Nevis	.046
		Martinique	.264
<i>American Gulf States*</i>	1940 <i>Population</i> MILLION	Puerto Rico	2.113
Texas	6.4	Surinam	.208
Louisiana	2.4	Trinidad and Tobago	.587
Mississippi	2.2	Virgin Islands of the U.S.	.030
Alabama	2.8	Windward Islands:	
Florida	1.9	Dominica	.051
		Grenada	.073
Total	15.7	St. Lucia	.081
		St. Vincent	.064
		Total Dependent Territories	6.081

* Source: *Encyclopedia Americana* (latest edition).

1. 1946 figures used.
 ** Source: "The Fish Trade of the Caribbean." External Trade Bulletin No. 3, Caribbean Commission, Central Secretariat.

GULF AND CARIBBEAN FISHERIES INSTITUTE

SECOND ANNUAL SESSION

Cooperating and Participating Organizations

Alabama Department of Conservation	Louisiana Department of Wildlife and Fisheries
Atlantic States Marine Fisheries Commission	Louisiana State University
Bagille's Seafood Co., New Orleans	Maryland Department of Research and Education
Bear's Bluff Laboratory, South Carolina	Maryland Department of Tidewater Fisheries
Bermuda Board of Trade	Merchant Marine and Fisheries Committee U. S. Congress
Caribbean Commission	Miami Beach Convention Bureau
Chesapeake Bay Institute, Johns Hopkins University	Mississippi Agriculture and Industrial Board
Chesapeake Biological Laboratory	National Fisheries Institute
Clearwater Freezer Co.	North Carolina Department of Conservation and Development
College of Agricultural and Mechanical Arts, Puerto Rico	Office of Naval Research
Container Corporation of America, Orlando	Oyster Institute of North America
Crosland Fisheries, Miami	Rod and Reel Club, Miami Beach
Davis Fish Company, Cedar Key	Shark Industries, Inc.
East Coast Fisheries, Miami	Smithsonian Institution
Florida Brotherhood of Fishermen, A.F.L.	South Carolina Board of Fisheries
Florida Commercial Fisheries Association	South Florida Anglers Club
Florida Federation of Wildlife Clubs	Southwest Research Institute
Florida Game and Freshwater Fish Commission	Sponge Institute of America
Florida State Board of Conservation	Texas A & M College
Florida State Board of Health	Texas Game, Fish and Oyster Commission
Florida State University	The Miami Daily News
Food and Agriculture Organization of the United Nations	The Miami Herald
Franz Theodore Stone Laboratory, Ohio	The Southern Fishermen
Government of the Bahamas	University of Florida
Government of Bermuda	University of Havana
Government of Martinique	University of Tampa
Government of the Netherlands	University of Texas
Gulf States Marine Fisheries Commission	U. S. Department of State
Hale Fisheries, San Francisco	U. S. Embassy, Mexico City
Hofstra College, Hempstead, N. Y.	U. S. Fish and Wildlife Service
Humble Oil and Refining Co.	U. S. National Park Service
Instituto Finlay, Havana	Vitamine Laboratories, Hialeah
Johns Hopkins University	Wayne University, Detroit, Michigan